THE UNIVERSITY OF ALBERTA

THE BOSS HILL SITE (FdPe 4) LOCALITY 2: PRE-ARCHAIC MANIFESTATIONS IN THE PARKLAND OF CENTRAL ALBERTA, CANADA

BY

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ABSTRACT

This study focuses on the earliest archaeological component at the Boss Hill Site, Locality 2, located on the northeast shore of Buffalo Lake in central Alberta.

Based on the identification of 19 vertebrate and 9 invertebrate taxa, and of a few botanical remains, a local parkland environment is postulated for this occupation which has been radiocarbon dated 7875 $\pm$ 130 years B.P. and 7750 $\pm$ 105 years B.P.

Using an ecological model, it is proposed that such prairie-forest transition zones, because of their floral and faunal diversity, served as a sphere in which two separate technological traditions came into contact, on an intermittant seasonal basis. This contact gave rise to the Pre-Archaic, a transitional phase between late Palaeo-Indian and Early Plains Archaic traditions. It is characterized by the coincidence of lanceolate and notched projectile points.

For the Parkland of Alberta, it is proposed that the Pre-Archaic began approximately 8,000 years B.P. and terminated approximately 7,000 years B.P. This transitional phase parallels the Pre-Archaic as defined in Texas, with implications for temporal, technological, and ecological similarities.

Analysis of artifacts and cultural features suggests a hunting and gathering lifestyle for the prehistoric occupants of the Boss Hill Site. There is particular emphasis on the utilization of large, medium, and small mammals, the hunting of waterfowl, fishing, and the gathering, and processing of vegetable foods, all of which reflect the resource diversity of the Parkland.

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INTRODUCTION

BACKGROUND

During the last two and one-half decades, the literature regarding typology of Plains Palaeo-Indian complexes has been dominated by the ideas of Henry T. Irwin and Marie Wormington (Irwin 1968, 1971; Irwin and Wormington 1970; Wormington 1957). Together they developed what is regarded as "stacked chronologies" (Pettipas 1981: 13) in which

> . . . one or more components make up a complex characterized by a single projectile point type. Both stratigraphy ... and radiocarbon dating ... demonstrate a succession of these types in time, on the Plains; and while there is variation in the projectile points of a type, there is no overlap between the successive categories themselves (Irwin and Wormington 1970: 24).

However, during the same period of time an increasing body of evidence suggested the mixing of different Palaeo-Indian "types" in a single occupation. In addition numerous sites on the Plains and Plains periphery had components in which Palaeo-Indian lanceolate projectile points were mixed with notched Archaic points. The associations in the former case produced views which were at odds with those of Irwin and Wormington . . .

> Typological differences between various named types of Parallel Flaked points may have little chronological meaning because different "types" frequently occur together in the same bison kill sites (Olsen-Chubbuck, Finley, Horner, and Scottsbluff) (Wendorf and Hester 1962: 168).

To rationalize this mixing of "types", Wendorf and Hester (1962: 168), in communication with E. Mott Davis, suggested that

"the named types may represent band distinctions."

In light of the stacked chronology viewpoint, the validity of the coexistance of two or more of the traditionally defined Palaeo-Indian projectile point assemblages was questioned. This skepticism was reaffirmed when Palaeo-Indian lanceolate points were found together with Archaic notched points. However, in 1959, the excavation of the Renier site, a cremation burial near Green Bay, Wisconsin (Figure 1), helped to resolve part of the dilemma. With the human remains were found Eden and Scottsbluff points, together with a side-notched point. To account for this assemblage Mason and Irwin (1960: 47) suggested:

> The presence of the side-notched point in the otherwise Scottsbluff assemblage strongly suggests contemporaneity and establishes as bedfellows two projectile point types which do not usually occur together. The sharp difference in material flaking technique as well as the fact that only a single example was found could indicate that the side-notched point was an intrusion and does not actually belong to the other material at all. The type of breakage, however, means that all points from the ridge were broken in the same way, and lacking evidence of any possible natural agency, it must be assumed that they were all broken together, in the same fire that seemed to cremate the individual whose remains were found on the ridge.

With this discovery, Mason and Irwin (1960) had suggested as coeval, lanceolate and notched projectile points. They believed that ". . . some sort of culture-contact, rather than developmental, situation was represented, one between Archaic and Palaeo-Indian traditions" (Mason and Irwin 1960: 48).

More than a decade later Sollberger and Hester (1972) reviewed evidence from several sites in central Texas in which

lanceolate points and notched points appeared to be coeval. This led to their definition of this phenomenon as a manifestation of the "Pre-Archaic."

The term Pre-Archaic has previously been used by Caldwell (1958: 8-11) in reference to a similar phenomena in the south-eastern United States. In defining the Pre-Archaic, Sollberger and Hester stated that it ". . . represents a transitory (transitional?) period following the late Palaeo-Indian occupations and predates the beginning of the local Archaic traditions" (Sollberger and Hester 1972: 327).

In reviewing the evidence for the occurrence of expanding-stem and corner-notched dart points characteristic of the Pre-Archaic period in Texas, Sollberger and Hester (1972: 338) suggested that:

> The earliest known examples of these points appeared during the late Palaeo-Indian period ... we do not know when this form first came into use, but it is evident that they were partially contemporaneous with Plainview variants, Angostura and other lanceolate points, and perhaps with other types.

Pollen studies in Texas have shown that the Pre-Archaic manifested itself in an area of parkland vegetation. A period of prolonged aridity during the Altithermal which began around 7950 - 8950 years B.P. and ended slightly before 5950 years B.P. "marked change from the parkland vegetation characteristic of Late Palaeo-Indian times to grassland savannas" (Sollberger and Hester 1972: 340).

For Texas, Sollberger and Hester (1972: 338) proposed that:

> It is our hypothesis that the transition from late Palaeo-Indian to Early Archaic occurred over a long time span in parts of Texas, probably the period between 7,950 and 5,450 years B.P.

OBJECTIVES

This study reports on the first relatively intensive archaeological excavation in the Buffalo Lake area of central Alberta (Figures 1 and 2). It represents, however, only part of the results of an overall project aimed at documenting and developing a regional archaeological chronology for the Parkland of Alberta.

A general ecological framework was used as a guide to research strategy since the location of plant and animal resources, in a very large measure, determined the location and distribution of past human settlements. King and Graham (1981: 139) have stated:

> Before ecological models are employed to explain spatial or temporal settlement - subsistance changes, however, the environment must be thoroughly understood through the application of data from independent disciplines. The modern plant and animal assemblages must be recognized and tied to their limiting factors of pedology and climate. In addition, if an archaeological site lies near an ecotone, the importance of that ecotone must be determined . . . Only when there is spatial and temporal difference in resources will scheduling and settlement patterns be affected and will there be adequate change so that the homeostatic mechanisms maintaining stable cultural relationships and subsistance actitivies may be altered.

This project therefore has been guided by the principles stated above and represents, under the constraints placed on resources, the undertaking of an interdisciplinary approach to gathering and interpreting cultural and ecological data.

In light of Sollberger and Hester's (1972) statements regarding the Pre-Archaic in Texas, the general objective of this study is to demonstrate that a similar, perhaps parallel, phenomenon was present on the northwestern periphery of the Plains, in the Parkland of central Alberta.

This objective will be achieved by the elucidation of the following specific objectives:

1. Substantiation of lanceolate and notched projectile points as coeval through stratigraphic association.

2. Establishment of a preliminary chronological framework for the Pre-Archaic in Alberta using radiometric and stratigraphic data from the Boss Hill Site Locality 2, FdPe 4.

3. Suggestion of a possible local environmental reconstruction based upon ecological data recovered from the Boss Hill Site.

4. Suggestion of a lifestyle of Pre-Archaic people at Boss Hill through the analysis of cultural features, tools, faunal and floral remains.

5. Suggestion, using geological data, of reasons for the specific preservation of the Boss Hill Site, and perhaps a basis for finding similar sites elsewhere.

6. Suggestion of possible technological derivations of the two projectile point traditions which characterize the Pre-Archaic at the Boss Hill Site.

7. Establishment of a terminal date for the manifestation of the Pre-Archaic as suggested by comparative sites.

8. Development of a hypothesis for cultural transition in the Parkland of Alberta.

PREVIOUS RESEARCH

The earliest recorded archaeological work in the Buffalo Lake area was in 1959, conducted by R.G. Forbis, then of the Glenbow Foundation. On the basis of the information obtained

from an informant, Forbis recorded an unnamed buffalo jump site on a steep slope in the northeast corner of Buffalo Lake and gave it the Borden designation FdPe 4. In addition, he recorded the Buffalo Lake Metis Site about one kilometre north of Boss Hill (FdPe 1), and also two other sites. One of the latter was a possible buffalo pound on the east side of the hill.

In 1964, A.L. Bryan and R. Gruhn of the University of Alberta surveyed the northeast shore of Buffalo Lake. At this time the Borden designation FdPe 4 was directly assigned to Boss Hill on the SW 1/4 Section 11, Township 41, Range 20, West of the 4th Meridian. In their report, Bryan and Gruhn described a site in a buried soil partially exposed on the top of Boss Hill (our Locality 1). In addition, their sketch map indicated the presence of bone on the road along the base and to the northeast of the hilltop site.

Provincial Museum of Alberta projects in Historic Archaeology began in 1965 with the excavation of early fur trade sites along the North Saskatchewan River. By 1970, a fairly substantial data base had been obtained on the period between 1792 and 1813, and relating to both Hudson's Bay and North West Companies. Later archaeological components of a "pure" nature (i.e. of short duration, well-defined in time and space) were, however, relatively more difficult to isolate owing to the amalgamation in 1821 of fur companies, and the consequent longer duration of settlements.

Therefore, it was suggested that investigations be made of a period essentially post-dating the major thrust of the fur trade. Several late nineteenth century metis sites were known, and

it was decided that one of these should be investigated.

Abundant surface evidence was observed at the northeast corner of Buffalo Lake, where a number of apparent cellar pits and stone fireplace bases were encountered, generally following the crest and sides of a low aspen-covered ridge about .5 kilometre east of the lake shore. Excavations were initiated here on two of the more badly disturbed cabin localities.

The Boss Hill Site was visited several times with Robert S. Kidd in conjunction with the field program he had initiated at the Buffalo Lake Metis Site. As part of the archaeological study of the area the author conducted a survey of Boss Hill in the summer of 1973.

At that time a side-notched projectile point and several flakes were found eroding from a buried soil on top of Boss Hill (designated Locality 1). Later that same summer, excavations revealed a multi-component site with diagnostic artifacts including medium sized side-notched points resembling Besant and Oxbow types. Faunal remains were predominantly those of bison with the exception of a pronghorn antelope phalanx.

In September of 1975, two small test pits were excavated adjacent to the trail in order to discover the vertical extent of the occupation and its relationship to the occupations on the top of Boss Hill (Locality 1). This Site at the base of Boss Hill was designated Locality 2, although still retaining the same Borden designation as Locality 1, FdPe 4.

The test excavation at Locality 2 suggested a single prehistoric occupation of relatively recent age with a ceramic

tradition. Preliminary lithic analysis suggested the importance of hide preparation, assuming the scrapers were used for this activity. Lithic debris indicated the use of a wide variety of raw materials, some of which did not occur locally. Local quartzite and chert pebbles predominate among raw materials utilized in workshop activities.

Test excavations at Locality 1 recovered projectile points and other evidence of human occupations from strata or a stratum dating 2,355 $\pm$ 70 years B.P., and an Oxbow-like projectile point from a lower stratum. Combined with the McKean-like basally notched projectile points recovered from the surface of Locality 2, they suggested that the northeast Buffalo Lake area was occupied at least seasonally by man for approximately 5,000 years. Furthermore, an Eden-like point (Doll and Kidd 1976: 5) was found in the general northeast Buffalo Lake area by Mr. Ben Weber of Sedgewick, Alberta. Historical occupation by Cree and Metis continued into the late nineteenth century. Based on this evidence, the author hypothesised at that time that Buffalo Lake, and especially its northeast corner served as a campsite and resource area for man during perhaps the last 7,000 years.

CHAPTER II

THE STUDY AREA

PHYSIOGRAPHY

The Buffalo Lake region of south-central Alberta (Figure 1) is characterized by a glaciated landscape with numerous moraine and outwash features. Perhaps the most appropriate descriptive term for the Buffalo Lake region is that of "hummocky moraine", used to deisgnate areas of knob-and-kettle topography (Gravenor and Kupsche 1959: 52). The largest of the knobs is Boss Hill, a two kilometre-long ridge paralleling the northeast shore of Buffalo Lake, the largest of the kettles. Boss Hill rises approximately 40 metres above the present lake level, which is 783.24 metres above sea level. The Boss Hill Site; Locality 1, is located on top of the northern portion of Boss Hill, Locality 2 is situated at the northeastern portion of its base. Both localities lie within L.S.D. 3, Section 11, TP. 41, R. 20 west of the 4th meridian (Figure 2).

The Buffalo Lake moraine system, in which the Boss Hill Site is found, covers the entire eastern part of the Central Highland physiographic division and extends beyond it to the north and east. This system surrounds Buffalo Lake, near which the knob-and-kettle topography is strongly developed, and includes the broad surrounding area of more moderate knob-and-kettle topography, most of which is dead-ice moraine (Stalker 1960a: 8-9).

The formation of the Buffalo Lake hummocky moraine system is associated with the relatively slow movement of the glacier over the rough highland of the area, compared to its relatively rapid

movement over the adjacent lowland. This slow advance resulted in less erosion and greater deposition on the high ground. Remnant ice blocks in fields of stagnant ice were responsible for producing kettles of depressions (Stalker 1960a: 29).

The glacial deposits in the area are derived from the Keewatin or Laurentian ice sheet that originated in the vicinity of Hudson's Bay. The detrital material consists largely of igneous and metamorphic rocks such as granite, gabbro, gneiss, schist, agrillite, greenstone, and material of local derivation such as harder sandstone and shale from the younger rock formations under the Plains, over which the glacier moved (Allan and Sanderson 1945: 19).

The two most important physiographic features with respect to this study are Buffalo Lake and Boss Hill. Buffalo Lake, the largest lake in the area, is an interior drainage type and represents the local base level of deposition. It lies on the Edmonton Formation and receives considerable spring water. Over most of its area, Buffalo Lake ranges from .61 to 1.52 metres in depth. In some portions a maximum depth of 5 metres has been recorded (Allan and Sanderson 1945: 17).

Tail Creek forms the outlet on the southwest end of Buffalo Lake. It has a wide and relatively mature valley suggesting that it is pre-glacial in age (Allan and Sanderson 1945: 17). This creek was noted by the author to flow only during spring runoff or during periods of high water in Buffalo Lake. It is presently dammed in several areas by beaver. This intermittent flow is perhaps explained by the presence of till ridges which surround Buffalo Lake and which

tend to make good impermeable shores (Stalker 1960a). Water escapes from the lake and numerous adjacent ponds mainly by evaporation, and as a result they are alkaline.

Boss Hill, the second feature, is interesting because of its structure. It forms the longest and highest ridge in the area and is therefore, a prominent landmark. In addition to its size, it differs from the other till ridges in the immediate area in that its deposits are stratified, and it has been defined by Stalker (1960a) as a "moraine plateau".

Boss Hill was probably formed in the following manner:

> During deglaciation crevasses and holes of various types were present in the base of the ice. At the same time the sub-ice material, generally till, but in places bedrock or other material, was either not frozen or only partly frozen. It also contained much water, commonly being completely saturated, and thus was in highly plastic or fluid condition. The weight of the ice on this plastic material pressed it towards the crevasses and holes, increasing the amount of material there while decreasing the amount beneath the ice. In the large holes most of the pressed material came to rest around their margins and only a little near the center. When the ice finally melted the material that had been pressed into the crevasses and holes stood as ridges, whereas the places from which the material has been pressed were low and commonly formed troughs and dead-ice hollows alongside the ice-pressed ridges (Stalker 1960b: 19).

The central ridge which forms Boss Hill is flanked on both sides by stratified sediments. Stalker (1960b) suggests that the water-deposited sediment contained in, or associated with, most of such ridges was deposited by water flowing along the crevasses or by streams pouring into the holes, building deltas at their margins and depositing fine material over the centers.

Upon examination of Boss Hill in cross-section, it appears that ice at one time was present only on one side of this ice-pressed ridge; here again Stalker (1960b: 22) provides an excellent description of the process involved:

> Where the ice was present on one side only of an ice-pressed ridge, the slope of the distal side is less steep than that of the proximal, or iceward side. While rising, apparently the ridge contained too much water, which aided flowage and slumping of the till during its construction. This gave a gentle slope to the distal side where ice was not present to support the rising ridge. Water slowly drained from the ridge as time passed and, when the retreat of the ice from the proximal side allowed slumping to take place there, the material was fairly dry. The resulting steeper angle of repose of the material gave a steep slope to the proximal side of the ridge. Also, in the dead-ice plateaux, water in contact with the inner slope of the rim ridge would have aided slumping during construction of these ridges.

Where slumping has not occurred, varied silts and clays give some indication of the rate at which the sediments filling the center of the moraine plateau were deposited. Stalker (1960b: 30) assumes that these sediments are deposited annually and that they can build up in tens or even hundreds of years. In any event, relatively long periods of quiet water or ice are indicated.

In addition to deposits which can be accounted for by ice-pressing processes, Boss Hill is capped by dune sand which is in places up to three metres in thickness. Dune formation in the Buffalo Lake moraine probably started immediately after the retreat of the last glacier and before the establishment of much vegetation (Stalker 1960a: 48). It may have been particularly active during

the post-glacial climatic optimum. The origin of the aeolian sand was probably the basin of adjacent Buffalo Lake. If indeed this was the source, the basin would have had to be dry. Schweger et al. (1981) have presented data demonstrating very dramatic drops in lake levels during the Altithermal. Many of the lakes studied were located in the northern Parkland and southern Boreal Forest of Alberta, and their relative nearness to the Boss Hill Site suggests that similar lowering of water levels effected Buffalo Lake.

At the base of Boss Hill, slopwash may account for the most recent deposits overlying later archaeological material. These deposits are dominated by Orthic Black Chernozemic soil with Eluviated Black Chernozemic subdominant (Clayton et al. 1977). These soils are associated with native vegetation of mesophytic grasses and forbs charactertistic of the Frescue Prairie-Parklands of Western Canada. While most Black Chernozemic soils have a relatively high inherent productivity, this is limited by such factors as light and moisture as well as short and cool growing seasons (Clayton et al. 1977: 106-107).

CLIMATE

Lying within the parkland belt at approximately 52°30' North latitude (Figure 1 and 2), the Boss Hill Site has a climate which is generally characterized by short hot and sunny summers and cold dry winters. The climate of the area is influenced by two winds. The westerlies carry maritime arctic or maritime polar air, both of which are warmer and moister than continental arctic winds. Both of these air masses undergo dessication in crossing the succes-

sive mountain ranges of British Columbia and frequently appear as "chinooks" of remarkable warmth and low humidity in southern Alberta (Kendrew and Currie 1955: 14). Northerly and northwesterly winds carry continental arctic air which is always intensely cold and dry.

Perhaps the outstanding climatic feature is the enormous range of temperature from summer to winter. The four yearly periods based upon temperature ranges include spring, from March to May with a mean daily temperature of 2.5°C. Summer, from June to August, has a mean daily temperature of 17.5°C. In autumn, from September to November, the mean daily temperature for the Buffalo Lake region is 5.8°C, while winter, from December to February has a mean daily temperature of -15.0°C (Longley 1972).

The highest temperatures during the summer exceed 43°C in the south of Alberta with 38°C nearly everywhere else. The record high temperature recorded for the prairie region was 45°C. In the other extreme, temperatures have been recorded below -51°C for the winter (Kendrew and Currie 1955: 124; Longley 1972: 23).

There is relatively small effective precipitation in the region, with a mean annual average of approximately 406 mm (Kendrew and Currie 1955: 131). About 30 percent of this total is due to snow. With an annual mean of between 76 mm and 127 mm, snowfall persists for about four months from December to March, but is less pronounced during February (Kendrew and Currie 1955: 134). Blizzards and heavy drifting of snow are frequent, especially in more open areas.

General mean values for temperature and precipitation can also be modified by local topographical features, giving rise to what is called "local" climate (Kendrew and Currie 1955: 67). This may be in evidence only in certain seasons and times of day and in certain types of weather; the effects at other times may neutralize it so that no pecularity appears in the mean values. Buffalo Lake, Boss Hill, and the surrounding strongly developed glacial terrain certainly tend to modify local climate. The earliest frost in autumn and latest in spring are found in the kettles or hollows of the area. These hollows can be intensely cold, much colder than the surrounding area. With larger bodies of water such as Buffalo Lake, the temperature fall is delayed in winter, but so too is the temperature rise in spring.

Local vegetation can also tend to modify climate locally. Forests or stands of trees tend to reduce wind according to their density and height. A light to moderate wind can be reduced to almost calm at ground level. In addition, blizzards are never as severe and there is little drifting of snow, which remains as a uniform white carpet (Kendrew and CUrrie 1955: 68).

FLORA

The Boss Hill Site (Figures 1 and 2) is situated within the Aspen Parkland of Central Alberta. This vegetation zone occupies an area between the Great Plains of central North America and the Boreal and Montaine Forests to the north and west. Stretching from northwestern Minnesota and Montana to near Edmonton, Alberta, this zone extends some 1440 km from south to north. It extends westward

from southern Manitoba, through central Saskatchewan, and across Alberta to the southern foothills of the Rocky Mountains (Bird 1961: 1; Shelford 1974: 319).

The Aspen Parkland (Figure 2) that characterizes the Buffalo Lake area contains two major ecosystems, woodland and grassland, which tend to form a patchwork of aspen stands and irregular open grassy areas. Scattered throughout are several bodies of water dominated by Buffalo, Boss, and Lynn Lakes including numerous smaller permanent and temporary sloughs. One would thus expect to find great diversity in the area's floral assemblage.

Although the Aspen Parkland as a whole has tended to be viewed as an ecotone or interface between climax grass and forest communities, some would prefer that a more critical use of the term be adopted. Bird (1961: 4) suggests that an ecotone exists only at the point of contact between the two types of communities; thus, the ecotone exists only around each grove of aspen or grassy meadow within the zone. In this monograph, however, the study area, and the Aspen Parkland of which it is a part, shall be considered as an ecotone following the more generalized definition.

In the Buffalo Lake region, the forest communities are dominated by aspen poplar (*Populus tremuloides*), which can be considered a climax species here. When in contact with more northern or western coniferous or mixed wood forests, it is considered seral to white spruce, *Picea glauca* (Bird 1961: 12). White spruce is a climax species particularly along the north-facing valley slopes of Meeting Creek and the Battle River to the northeast, and along Tail Creek which flows south from Buffalo Lake toward the Red Deer River.

The grasslands of the Buffalo Lake area may be similar to those described by Moss (1944) and Moss and Campbell (1947), (cited in Bird 1961: 5). While the dominant grass in upland areas is rough fescue, Festuca scabrella Torr., a dominance which is continued to the southernmost extremity of the zone in Montana, the three main grass species in the area from Saskatoon west to the black soils of Alberta also include porcupine grass, Stipa spartea Trin. var. curtiseta, Hitchi, and June grass Koeleria cristata (L.) Pers. These three grasses account for about 50 percent of the basal cover (Bird 1961: 5), several sedge species make up about 25 percent of the cover, while secondary grasses form about three percent of the cover.

The principal species which comprise about 70 percent of the forb cover (about 20 percent of the total cover) include low goldenrod, Solidago (missouriensis Natt); pasture sage, Artemisia frigida Willd; pasque flower or prairie crocus, Anemone patens L. var. wolfgangiana (Bess.) Koch: small everlasting, Antennaria (nitida Greene Bydby); moss phlox, Phlox hoodii Richardson; and field chickweed, Cerastium arvense L. The remainder is made up of about three percent prairie rose, Rosa arkansana, and about 30 percent of 14 other species of herbs and two other species of shrubs of which buckbrush, Symphoricarpos occidentalis Hook, and wolf willow, Elaegnus commutata Bernhi, are considered the most important (Bird 1961: 5-6).

Sloughs in the area support varying types and amounts of vegetation along their margins depending upon the degree of alkalinity. Those with lower alkalinity tend to support willows, which can be partially submerged during times of higher water levels. Those

with high alkalinity, for example Boss Lake (Figure 3), have no growth of willows along their margins but are surrounded by salt-tolerant grasses and other plant species near the shore.

Adjacent to these shoreline communities, balsam poplar, Populus balsamifera, replaces aspen. On the most heavily wooded east-facing slope of Boss Hill between Buffalo and Boss Lakes, some paperbirch, Betula papyrifera, is interspersed with the aspen.

Bird (1961: 24) suggests that for the greater portion of the Aspen Parkland vegetational succession trends toward a forest climax. One of the more interesting observations made by the author while conducting field research in the area from 1973 to 1980 was the dynamic relationships among grassland, forest, and aquatic communities.

During particularly dry years, for example, many of the small sloughs dried up completely in early summer, with the resulting succession from aquatic plants to grasses. At many of the smallest and shallowest of the sloughs, young balsam poplar saplings emerged and succeeded grasses in those areas that were submerged only two seasons previously.

The reverse situation was also observed. A particularly heavy snowfall during the winter of 1973-74 resulted in raised water levels in Buffalo Lake and the surrounding lakes and sloughs in the spring. Aspen and baslam poplar saplings which has invaded the margins during previous years became partially submerged, died, and were replaced by aquatic vegetation and lake margin grasses. In addition, observations made between 1974 and 1980 showed dramatically a new succession from aquatic to grassland meadow vegetation and,

most recently, to forest succession in some parts of the study area.

The most notable agent affecting vegetational succession was fire. Lightning-caused fires significantly reduced the encroachment of forest communities. In addition, the use of fire by man to alter ecological succession is well documented from many parts of the globe (Hough 1926; Stewart 1955). In tropical climates, for example, slash and burn horticulture was the rule both in prehistoric as well as modern contexts.

The use of fire by man has quite recently come under increased scrutiny with respect to land management by the forest services as well as becoming a more academic anthropological area of study (for example, Lewis 1977).

Records of the earliest historical manipulation of fire in the Aspen Parkland are found in the accounts of early fur traders and explorers such as Alexander Henry the Younger of the North West Company (Coues 1897) and Hind (1859). These Accounts cover periods of the early and middle 19th century. Prehistorically there is stratigraphic evidence of prairie fires occuring sporadically over perhaps the past thousand years at Locality 1 of the Boss Hill Site (Doll 1980). Bird (1961: 29) also suggests that fires were set so frequently they maintained a prairie sub-climax.

The European Settlement of the Buffalo Lake area at the turn of the 20th century has had a profound ecological effect. Farming practices resulted in the destruction of much native grassland in favor of cultigens and the inevitable weeds that accompany them.

Interviews with early settlers by the author indicated that grassland was dominant in the Buffalo Lake region during the

early part of the 20th century. The area along the east slope of Boss Hill was essentially treeless until fires were controlled by the settlers. Apparently the only nearby source of logs for building material was about a kilometre north of Buffalo Lake. In addition, early photographs of the area in the possession of my informants showed much higher water levels in Buffalo Lake and the surrounding area (A. and H. Hays, personal communication).

Prior to 1920, Boss Lake, Lynn Lake, and many of the adjacent sloughs were connected to Buffalo Lake and, indeed, were navigable by canoe. This would indicate lake water levels at least four metres higher than those recorded in the 1970's. In addition, the author observed Boss Lake (Figure 3) during the summer of 1981 noting that it was almost completely dry. This <u>dramatic fluctuation</u> in the water levels observed over a period of less than a century is an important analog to what had taken place in the same area during the Altithermal.

The earlier recorded high water levels probably isolated stands of aspen, protecting them from the ravages of prairie fires. At present, control of fires is responsible for the mature stands of aspen which can be seen on the slopes of Boss Hill and many parts of the surrounding countryside.

During the period from 1975 to 1980, the Fish and Wildlife Division of Alberta Energy and Natural Resources compiled floral and faunal species lists for the Buffalo Lake area. Complementing an annotated list of birds submitted by four local naturalists familiar with the area, a floral and faunal list was compiled by Dr. C. Bird.

The floral list in turn has been supplemented by species identified by Julie O. Hrapko along a transect running between Boss Lake and Buffalo Lake (Figure 3). In addition, those plant species with known ethnobotanical use by Native People have been annotated. This list (see appendix I) includes the identification of 325 species: 15 fungi, 22 lichens, one liverwort, 15 mosses, two ferns and fern allies, three conifers, 61 monocots, and 206 dicots.

Although diversified land use as reflected by agriculture and ranching has generally influenced the mosaic of the Aspen Parkland, areas within the Buffalo Lake region remain where more or less original parkland floral assemblages and vegetational succession patterns can still be observed. These observations can, with prudence, be useful as an aid to the reconstruction of past environments.

FAUNA

A rich and varied faunal assemblage exists in the Buffalo Lake region. This reflects the Aspen Parkland biome of which it is a part, and the varied pattern of present-day land use.

At present, areas adjacent to Boss Hill include cultivated land where various cereal and fodder crops are grown, as well as open meadows which make up pasture for domestic livestock. In addition to Buffalo, Boss, and Lynn Lakes, there are several permanent and temporary sloughs, some of which serve the needs of livestock as well as providing excellent habitat for waterfowl, shorebirds, and small mammals.

A fairly extensive portion of the area is now forested

with large stands of aspen or mixed aspen and birch. The edges of these stands combined with the adjacent meadows provide excellent habitat for the two most common large mammals in the area, the white-tail and mule deer.

The abundance of bison bone in the shallow lagoons and along the margins of Buffalo Lake attests to the predominance of these large herd animals in the past. Today, however, cattle are the largest mammals to be found in the area.

The faunal list compiled by the Fish and Wildlife Division of the Department of Energy and Natural Resources, supplemented by my own data, includes a total of 183 animal species identified between 1975 and 1981. Included are 12 species of snails, six fish, six amphibians and reptiles, 98 birds, and 25 mammals (see Appendix III). A notable addition that should be mentioned here is moose. Occasional moose have been observed and at times shot in the area in recent times. In addition, moose have been identified from the faunal remains of the historic Buffalo Lake Metis Site, FdPe 1, (Brian Kooyman, University of Calgary, personal communication).

Reflected in the faunal check-list is the fact that the Buffalo Lake area is presently very important with respect to the breeding of waterfowl. In addition to several species of surface and diving ducks, Canada Geese breed in the area.

In the fall, the Buffalo Lake area attracts hunters in droves as the lakes and surrounding woodlands serve as a staging and resting stop for migrants from the north including Snow and White-fronted Geese.

Since cultivation has enriched the habitat for mammals such as deer, the tremendous increase of this species since the turn of the century has also attracted big-game hunters to the area.

Available records combined with field observations and interviews have served to reemphasize the richness and diversity of fauna in the area. Mammals such as beaver and muskrat are again common. The showshoe hare, except during natural cycles of scarcity, can be found in the thickets adjacent to and within the forested areas. With the increase in the populations of these mammals come predators such as coyote, weasel, Goshawk, and Great Horned Owl.

Although there is a notable historic shift in the dominant large mammal species (bison and elk to mule and white-tail deer), fish and avifauna, particularly waterfowl, continue to serve as an economic and recreational resource to man.

CHAPTER III

METHODS

EXCAVATIONS AT THE BOSS HILL SITE, LOCALITY 2

As a prelude to excavation, an arbitrary north/south base line oriented six degrees west of magnetic north was established by transit at the Boss Hill Site, Locality 2. The area was then surveyed into two metre squares with excavation unit designations determined by the co-ordinates of their northwest corners. Stake 0N, 0W served as the central datum for the excavation, and was tied by transit to the foundation of a nearby cabin.

Out of a total of 19 excavation units investigated, nine were excavated to a depth of at least 320 centimetres below surface. These include units 0N, 10W; 0N, 12W; 0N, 14W; 2N, 10W; 2.5N, 10W; 2.5N, 14.5W; 5N, 13.5W; 2.5S, 10W; and 2.5S, 12 W (Figure 4).

Additional smaller excavations within three of these units were conducted in order to expose a shallow pond deposit located below the earliest confirmed human occupation (the first occupation). In these three cases, excavation continued to a depth of 360 centimetres below surface, and supplementary auger tests extended this to approximately 620 centimetres below surface (Figure 5).

Trowl and dustpan, and shovel-shaving excavation techniques were employed, depending upon the stratigraphic situations encountered. Excavation proceeded by natural and/or cultural stratigraphy, while at the same time maintaining a continuous series of ten centimetre arbitrary levels. Most backdirt was screened through

one-quarter inch or finer mesh. All portable artifacts were located in three-dimensions and recorded by unit, stratum, and level. The various levels, walls, and non-portable artifacts or cultural features were recorded through plan-views and profiles in conjunction with black-and-white and color photography. Level bags were taken to the archaeology labaratory at the Provincial Museum of Alberta following excavation. In addition, a considerable quantity of matrix from the lowest confirmed occupation, and a columnar soil sample, were collected for further analysis.

PALAEOENVIRONMENTAL RESEARCH

One of the objectives of the author's research at Buffalo Lake was to obtain data relfecting the ecological conditions of the area as experienced by the prehistoric occupants of the Boss Hill Site. Data were collected to reveal both the contemporary conditions at the site and those of the past. In order to establish a contemporary data base, the author obtained the co-operation of Julie O. Hrapko, Curator of Botany, and her assistants, Yvonne Rowland and Joan Kerik, of the Provincial Museum of Alberta. Hrapko, with assistance from the author and his crew, established a botanical transect beginning at Boss Lake and running west to Buffalo Lake. This line intersected both Localities 1 and 2 of the Boss Hill Site (Figure 3). Records were kept of those species which formed particular plant communities, while examples of most species were collected along the transect to be identified in the laboratory. From those plants collected, a list of speices of ethnobotanical significance was compiled and supplemented with data from pre-exis-

ting lists for the general area (see Appendix I).

Although Hrapko's research constituted a separate project, it is of significance with respect to comparison with and interpretation of the data from the archaeological site.

During the course of excavation, samples of organically rich matrix were collected from the first occupation. Many of these were collected adjacent to or from within hearths. This matrix was subjected to fine screening and flotation in order to separate seeds, plant fragments, and micro-fauna, some of which might be sensitive environmental and climatic indicators.

A continuous series of soil samples was collected from a 360 centimetre-deep profile subsequent to excavation. The profile had been cleaned back to a distance of at least 10 centimetres from the originally exposed surface in order to prevent contamination from the contemporary pollen rain. The analysis of these samples for fossil pollen was undertaken by Keary Walde and the results are summarized in Appendix VI.

Additional samples were recovered from a shallow pond deposit situated stratigraphically beneath the first occupation (Figure 5). Part of this sample was analysed for the presence of volcanic ash by Dr. Gerry Osborne and of ostracods by Maureen Galligher (see page 64). Miguel Bombin also collected samples from the Boss Hill Site. These are to be processed for phytolyths (plant opals).

To complement the recovery of plant fossils, the faunal remains excavated from the first occupation were examined for species that would be sensitive indicators of environment.

DATING SAMPLES

Four organic samples relating to the chronology of the first occupation at Locality 2 were collected at the Boss Hill Site. A high priority was placed upon the recovery of charcoal in order to obtain the most reliable dates. Fortunately, a sample of large lumps of charcoal was recovered from a hearth feature in the first occupation. This sample was recovered using clean tools with handling kept to an absolute minimum. Immediately upon recovery the charcoal was wrapped in aluminum foil and submitted to the radiocarbon laboratory.

Bone samples were selected only when insufficient charcoal was recovered, or when the context of the charcoal was doubtful. As in the case of recovered charcoal, bone was wrapped in aluminum foil and sent directly to the dating laboratory. At least 10 grams of charcoal or 500 grams of bone made up each sample.

In addition to the samples from within the occupation, a dating sample of decomposed organic material and charcoal was obtained from a shallow pond deposit situated approximately 50 centimetres below the first human occupation layer.

In addition, samples of volcanic ash were collected from above the human occupation. Dating sequences for the various ash falls in northwestern North America have already been well established (Westgate et al 1970). Identification of the volcanic ash above the human occupation was undertaken by Pam Waters (Appendix II).

CHAPTER IV

DATA

STRATIGRAPHY

The profile of the south wall of excavation unit 2.5N, 14.5W best represents the depositional sequence at Locality 2 (Figure 5). On the surface, contemporary artifacts such as bottle caps, broken glass bottles, marbles, and plastic cups attest to the present recreational use of the site (Occupation 1). The upper portion of the present A horizon (Depositional Unit IA_1) contained the remnants of a bison butchering operation which is dated 200 $\pm$ 60 years B.P. (Occupation 2). The thickness of this A horizon is highly suggestive of a relatively stable depositional period. Artifacts excavated from the base of this horizon (approximately 35 centimetres below surface) suggest, on typological grounds, an occupational date approximately 2,000 to 2,500 years B.P. (Occupation 3).

Following the profile downwards, from 40 centimetres to approximately 160 centimetres below surface, a series of buried and poorly developed A horizons are encountered (Depositional Units IB_2 to IIIAC). This suggests fairly unstable conditions with relatively rapid deposition of fine-grained colluvial material derived from the sediments on top of Boss Hill. A Duncan projectile point, typologically dating around 3,600 years B.P. (Brumley 1975), was excavated approximately 60 centimetres below surface within one of these poorly developed, rapidly buried A horizons (Occupation 4).

At about 90 centimetres below surface, a workshop featuring

biface production was encountered (Occupation 5). No radiocarbon samples were obtained nor were any typologically datable artifacts recovered. A tentative date of 4,462 years B.P. is suggested for this occupation based upon the calculated rate of sediment accumulation. Likewise an undated occupation at 126 centimetres below surface contained a large anvil stone and a quantity of broken bison bone (Occupation 6). This occupation is also tentatively dated at 5,120 years B.P. using the same calculations.

There is a rather dramatic change at approximately 184 centimetres below surface in the profile. There is a great increase in the amount of rodent activity, suggesting stable conditions once again, but more importantly, this activity implies dry soil conditions symptomatic of Altithermal dessication. Also in this section of the profile, volcanic ash, identified as derived from Mount Mazama (see Appendix II) was encountered. The Mazama Ash, dated at approximately 6,600 years B.P. overlies a buried A horizon which contained stone artifacts and associated broken animal bone (Occupation 7). This horizon and the occupation contained therein may date from approximately 6,600 to 7,000 years B.P.

The following 40 centimetres of profile consists of a rather homogeneous yellow-grey clay deposit rich in calcium carbonate concretions (Depositional Unit IVC). This appears to be a gleysol, as these types of soil occur in poorly drained positions in association with soils of several other orders (Canadian Soil Survey Committee 1978: 72).

The next 30 centimetres, beginning at approximately 220 centimetres below surface, represents the upper extent of the

pond deposit (Depositional Unit VA_1) and the upper stratigraphic limit of the first human occupation (7875 ± 130 B.P. and 7750 ± 105 B.P.). It is here that a noticeable downward slope, from west to east and south to north, occurs, defining the pond basin. Gastropods are very common from this level downwards to approximately 320 centimetres below surface.

The next 25 to 30 centimetres, to approximately 308 centimetres below surface, at the extreme eastern edge of the profile, are much darker in color due to the concentration of organic refuse as a result of human occupation (Depositional Unit VApi Occupation 8).

Below the first occupation, to approximately 332 centimetres below surface, is a series of culturally sterile horizons. In addition to containing a concentration of carbonates, some seven to ten centimetres in thickness, they terminate in a layer, approximately ten centimetres thick, which is rich in gastropods, ostracods, and botanical pond deposits. A radiocarbon date of 8090 ± 130 years B.P. was obtained from this layer, thus establishing the existence of the pond during the height of the Altithermal.

From 332 centimetres to approximately 600 centimetres below surface (the extent of our testing capability) the deposits were examined by means of auger boarings and consisted mainly of gleysols which are rich in calcium carbonate concretions. The presence of gleysols reflects the influence of "waterlogging for significant periods" (Clayton _et al_ 1977: 136). The gleysols present at Locality 2 appear to be eluviated gleysols which ". . . are usually found in topographic situations such as potholes or enclosed

depressional basins where the surface horizons may become saturated for short but significant periods by flood and meltwater, or by heavy rains, but which later in the season may become relatively well drained or even dry" (Clayton et al 1977: 136-138).

During the course of auger tests, several thin carbonate deposits were also encountered. It appears that this section of the profile, below the dated pond deposit, represents a period of very rapid deposition during relatively early postglacial times. One would also expect the rate of deposition to be particularly rapid when the ice-pressed feature of Boss Hill was still in a plastic state, for, according to Stalker (1960b: 19), the material forming Boss Hill would have been completely saturated, with slumping occurring immediately after the supporting glacial ice had melted. In addition, slope wash would contribute to this high rate of deposition prior to the establishment of stabilizing vegetation.

In summary, deposition at Locality 2 appears to have been relatively rapid from immediate postglacial times until the advent of a relatively stable depositional period approximately 6,600 years B.P. Within this long period of rapid deposition there is stratigraphic evidence for the presence of a pond. The organic material from the pond deposit, radiocarbon dated at 8090 $\pm$ 310 years B.P. suggests at least periodic wet conditions during the height of the Altithermal.

In light of recent observations of water levels in Buffalo Lake and the surrounding area, dramatic fluctuations appear as a result of relatively minor changes in local weather patterns. Fluctuations of four metres or more have been observed to have taken

place over a relatively short period of time. It would appear, therefore, that similar, and perhaps, more dramatic fluctuations occurred during the span of the Altithermal which began approximately 9000 years B.P. and persisted until about 6,000 years B.P. (Schweger *et al.* 1981: 58). The presence of both aquatic and terrestrial gastropods as well as ostracods (see Chapter IV), are faunal indications of this flucation. The presence of calcium carbonates in the gleysol also support the contention that water table fluctuations did take place.

By 6,600 years B.P. until about 3,600 years B.P., deposition once again become relatively rapid as evinced by the large number of buried, poorly developed, Ap horizons. Conditions appear to have stabilized around 3,600 years B.P., allowing for the development of the present soil profile.

The type of soil found in the upper portion of the Locality 2 profile is consistant with the nature of the parent material and the geomorphological processes which took place:

> Black soils are developed mainly on glacial till and glaciofluvial and lacustrine deposits, but also occur on eolian, alluvial, and colluvial materials. Most deposits are weakly to strongly calcareous and dominantly loamy in texture, although significant areas of coarse sandy and fine-textured clayey soils occur. The clayey soils are generally associated with glaciolacustrine deposits and level to undulating lake basins. Medium-textured soils usually occur on undulating to rolling glacial till and alluvial lacustrine landscapes, and coarse-textured soils on undulating alluvial eolian or outwash plains (Clayton *et al*. 1977: 106).

Mr. Keary Walde undertook the detailed sedimentological analysis of the soil samples collection from excavation unit 2.5N,

14.5W. The methodology and results are included in Appendix VI. In general, Walde found the textural results clustered within the clayey-silt to sandy-silt fractions. The high fine-textured soil fraction was perhaps influenced by the initial sorting of glacial materials during the formation of stratified deposits on top of Boss Hill in late glacial and immediate postglacial times. Subsequently, mechanical displacement of portions of this and later aeolian deposits, through slumping and slope wash, resulted in their collection at the base of Boss Hill. This, in turn, provided the parent material for subsequent soil development and a mechanism whereby evidence of human activity has been preserved.

NON-PORTABLE CULTURAL FEATURES

HEARTHS

Two hearths were excavated in the first occupation of the Boss Hill Site, Locality 2 (Figure 4). Hearth feature 1 was encountered in the 260 to 270 centimetre level below surface in the southeast corner in excavation unit 0N, 12W. Because of the horizontal limits of the excavation unit, full dimensions of this feature were probably not obtained. The hearth does not seem to have been lined or encircled with cobbles, but consisted of a concentration of organic material and associated stained earth, the exposed portions of which measured approximately 80 by 50 centimetres. The hearth was approximately ten centimetres deep. Ash, fragments of large mammal bone, probably of bison or elk, and large lumps of charcoal occurred in this feature. Radiocarbon analysis of the charcoal yielded a date of 7750 ± 105 years B.P. (Laboratory No.

S-1371).

The second hearth, feature 2 (Figure 4), was encountered between the 270 and 280 centimetre level below surface in the central portion and into the west wall of excavation unit 2.5S, 12W. This feature was bisected by the excavation and measured approximately 80 centimetres from north to south by 65 centimetres from east to west. Again due to the horizontal limits of the excavation unit, full dimensions could not be obtained.

As with the previous feature, there was no evidence for lining or encirclement with cobbles. The feature contained concentrations of ash, charcoal, and pulverized bones in a matrix of darkly stained earth. More or less basin-shaped, the hearth was approximately 25 centimetres in thickness and is perhaps an extension of the first hearth.

Associated with this feature was a quartzite biface (specimen 15, see page 44 and plate 2e), and several sharpening flakes of the same material.

WORKSHOPS

A relatively large concentration of stone flakes and an antler tine (specimen 90, see page 56 and plate 10b), were encountered in the 260 to 270 centimetre level below surface. The concentration was exposed in the northwest portion of excavation unit 2N, 12W, and the excavated part of the feature occupied an area approximately 80 centimetres from north to south by 30 centimetres from east to west (Figure 4).

In the northwest quarter of excavation unit 0N, 14W, and

in the 280 to 290 centimetre level below surface, a second workshop feature was discovered (Figure 4). The several hundred chalcedony flakes recovered appear to be detritus from the manufacture or resharpening of a biface (specimen 14, see page 44 and plate 2d).

Very few cultural features have been encountered in the first occupation. Except for the intact hearths, other features could only be defined in terms of concentrations and associations of cultural debris. In excavation units 2.5N, 14.5W, and 5N, 3.5W, for example, there were concentrations of ash, charcoal, and burned and unburned bone, in proximity to tools, including most of the projectile points recovered from the occupation (Figure 4). Although features in this area were not defined as such, the recovery of anvils, hammerstones, and butchering tools in association with pulverized bone suggests such activities as meat and bone cooking and processing. One large or perhaps several smaller hearths accounted for the abundance of charcoal.

Similar associations were noted in unit 0N, 10W, which was rich in stone resharpening flakes and in charcoal. Again no hearth structure was found.

The most coherent structural data is derived from the two identified hearth features. These provide evidence that hearth preparation was minimal. Hearths were constructed either immediately on the ground surface or in very shallow basin-shaped depressions. To date there is no evidence for the lining of such structures with cobbles in the first occupation as is typical of

later Plains Archaic occupations at Boss Hill (Doll 1980). The few scattered fire-broken cobbles encountered in excavation suggest use as boiling or cooking stones. However, the above evidence should be regarded as tenuous.

The lack of other structural evidence, for example, post holes indicating the presence of drying racks or supports for temporary shelters, may reflect a failure to excavate a sufficiently large area. Frost heaving might also account for the obliteration of such features, if they indeed did exist.

The structural evidence from the first occupation at Locality 2 can account for only temporary utilization of the site (see Figure 4). Activities suggested include butchering and cooking of animals, processing of bone for grease and marrow, and the associated use-modification of stone tools which would require resharpening during the course of such activities. The presence of grinding stones might also suggest the processing of plant material and perhaps small mammals.

Again it should be emphasized that the cultural remains recovered suggest temporary occupation of the site. Such an occupation, however, would be typical of small bands of mobile hunters and gatherers on their seasonal rounds.

PORTABLE ARTIFACTS

The first occupation at Locality 2 of the Boss Hill Site yielded a total of 90 portable artifacts exclusive of lithic detritus. Of this total, 97.78 percent or 88 artifacts were made of stone, with the remaining two artifacts made of bone and antler.

Raw material is dominated by the use of quartzite, representing 38.82 percent of the artifacts, and chert, which accounts for 25.88 percent.

Lithic raw material available from the local glacial deposits may account for up to 80 percent of the manufactured tools found in the first occupation, while 98.82 percent of the raw materials represented in the recovered tools can be found within a 160 kilometre radius of the Boss Hill Site. Notable among these raw materials are various types of chalcedony from Pliocene gravels found in the Hand Hills, an erosional remnant of a pre-glacial land surface south of Boss Hill. Mudstone comes from the Paskapoo bed-rock formation on the Red Deer River about 35 kilometres southwest of the Boss Hill Site. In the form of artifacts it tends to be abundant in the surface finds and excavated sites near the Battle River or its steeply incised tributaries. One artifact of brown chalcedony, very much like Knife River Flint, may have had its source farther to the south and east, perhaps in Manitoba or North Dakota.

Also noteworthy is the employment of bipolar pebble technique. This technology is represented in many of the earliest Palaeo-Indian assemblages in North America (MacDonald 1968) and persists through time. Evidence for this persistence was discerned at the historic Buffalo Lake Metis Site (FdPe 1) occupied up to the middle or late 1870's A.D. (Doll 1977a). Reduction of pebbles by means of a bipolar percussion technique appears to be the only practical method of dealing with the small chert pebbles found in the region. Several small tool types were manufactured using this

technique.

The following is a description of the artifacts recovered from the first occupation at Locality 2 of the Boss Hill Site. The classification scheme parallels those currently in use by Plains archaeologists.

PROJECTILE POINTS

Two "types" (Hole and Heizer 1969: 169-171) of projectile points are represented in the first occupation at Locality 2. These include two lanceolate specimens and five corner-notched specimens.

As far as the author has been able to determine, there are no similar dated points in a reliable archaeological context from the Parklands or the Plains area of the Prairie Provinces of Canada. However, lanceolate projectile points, similar to those excavated from the Boss Hill Site, were previously described in surface collection from the Parkhill Site (Figure 1) in southern Saskatchewan (Nero 1959; Ebell 1980). The Boss Hill specimens, are therefore included here under the term "Parkhill Lanceolate."

In the following section the reader's attention should be drawn to the photographic plates of the artifacts. The author's use of the terms right left, dorsal, ventral, proximal, and distal reflect the position of the artifact as illustrated.

1. PARKHILL LANCEOLATE

Two examples were recovered. Specimen 1 (Plate 1a), made of brown chalcedony, has been reconstructed from three heat-fractured fragments that were associated with a disturbed hearth feature in two adjacent excavation units. The base is straight with parallel

constricted lateral edges, ground on the lower third. There is evidence of grinding on the base as well; however, this treatment has been partially obliterated by two thinning flakes near the left margin. Final retouch or perhaps resharpening was performed subsequent to grinding. There was an abrupt demarcation between the ground and sharpened areas along the lateral edge, with the scars of the subsequent sharpening flakes overlapping those of previous flakes with heavily ground platforms.

This tool is lenticular in cross-section and the flaking is generally well executed. Pressure flakes have been detached perpendicular to the lateral edges, terminating at the mid-point of the dorsal and ventral surfaces, or slightly beyond. Flaking towards the base tends to run more diagonally while the base itself has been thinned by a series of flakes oriented perpendicular to the basal edge.

Specimen 2 (Plate 1b), is made from fine-grained translucent grey quartzite. The lower portion of the base is missing, presumably snapped off at the junction with the haft. This type of fracture has been demonstrated by experimentation to occur when lateral pressure or obstruction by bone is encountered when the point is projected into the ribcage of an animal (see Frison 1978: 334).

The workmanship on the second specimen is similar in pattern to the first, but the quality is much better, especially as one takes into consideration the problems inherent in the knapping of quartzite. Heavy grinding is evident along the lower

quarter of the parallel, constricted lateral edges. As in the first specimen, there is evidence of either final sharpening or resharpening subsequent to grinding along these edges.

With respect to the manufacturing sequence of the Boss Hill lanceolate points, there is an indication that the tool was first "roughed out" by percussion, then refined by pressure flaking. Subsequently, the lateral edges and base were ground. Initially this grinding may have served to provide strong platforms for final retouch sharpening. One-quarter to one-third of the length of the base of the tool was left unretouched, with these dulled edges perhaps functioning to prevent cutting of the binding once the point was hafted.

Subsequent resharpening would also tend to reduce the size of the tool, and, if done while hafted, would alter the general outline. There is some indication of this in the quartzite specimen, which exhibits slight indentation just above the distal limit of the ground lateral edge.

2. BOSS HILL CORNER-NOTCHED

Boss Hill Corner-Notched projectile points are physically not significantly different from those which have been typologically defined as "Mount Albion Corner-Notched" by Benedict and Olson (1978: 47-51). The similarities are reinforced if one takes into consideration the range of variation for the type (see Benedict and Olson 1978: Figures 37, 38, 55, 64, 65, 66, and 67). Several very important factors, however, serve to distinguish the Boss Hill examples from the Mount Albion examples. The most obvious difference

between the two is chronological. Mount Albion Corner-Notched points dated at 5900 ± 125 years B.P. (I-3267) and 5520 ± 190 years B.P. (I-9434) (Benedict and Olson 1978: 51) are significantly younger than the Boss Hill specimens dated at 7875 ± 130 years B.P. (S-1251) and 7750 ± 105 years B.P. (S-1371).

Central Colorado, the area in which Mount Albion has been defined, is separated from Boss Hill by more than 2,000 kilometres, and perhaps more significantly, there are no archaeological records for sites containing similar projectile points bridging the chornological gap, and located between north central Colorado and central Alberta. In addition to differences in time and space there are also contextual differences which tend to separate Mount Albion from Boss Hill Corner-Notched points. The latter are directly associated with lanceolate points generally considered to be Palaeo-Indian, while the former have never been found in such a context.

Less significant are the ecological differences between the two areas. Mount Albion points have been recovered in alpine contexts while Boss Hill points, as the author will attempt to demonstrate, were found in a parkland context.

Five specimens of Boss Hill Corner-Notched projectile points were recovered. Specimen 3 (Plate 1c) is made from burned shale. It is broken at the lower junction between the notch and the base. The angle formed by the remnant of the notch suggests rather wide corner-notching with sharp shoulders. Flakes were detached perpendicular to the convex lateral edge, and terminate at about the midpoint of the dorsal and ventral surfaces. This resulted in

the formation of a central ridge. R. Bonnichsen, University of Maine, (personal communication) on examining the artifact suggested that the knapper supported the center of the blank with a pad while flaking, resulting in the termination of the flakes and the formation of the ridge.

There is also evidence of slight grinding along one of the notches of this tool. The tip of the point appears to have been resharpened along the right lateral edge to about one quarter the length of the body. The resulting distal end is extremely sharp, a vital element in projectile point deisgn (see Frison 1978: 337-338).

Specimen 4 (Plate 1d), made of black chert, exhibits similar workmanship to the specimen previously described. Again, the base has been broken and subsequently reworked. There is grinding inside the left hand notch. The left blade margin appears to have been resharpened, terminating in an extremely sharp point.

The two smaller projectile points are more nearly complete. Specimen 5 (Plate 1e) is made of yellow-grey fine-grained quartzite. Corner-notching is very broad, forming an expanding stem and convex base. Both the notches and the base exhibit grinding.

The right shoulder is pronounced, the left less so. This can be attributed to the fracture which took place on the latter location. The body of the specimen is roughly triangular in outline. Observable asymmetry is probably due to repeated sharpening. The tip of the specimen appears to have been impact-fractured. Although present, the dorsal and ventral ridges on the body of the tool are

less pronounced than those on the larger specimens previously described.

Specimen 6 (Plate 1f) is made of brown chert. It exhibits rather wide corner-notching on the left side resulting in an expanding stem. The right side appears more side-notched. The base is slightly convex and ground. Grinding is also apparent along the stem margins. The body of the artifact exhibits the same pattern of pressure flaking as was found on the larger two corner-notched specimens. Likewise, the dorsal surface shows a pronounced ridge. The body, however, forms an equilateral triangle which is perhaps a result of the shortening of the tool by resharpening (Plate 1f).

Specimen 7 (Plate 1g) is represented by a projectile point basal fragment. Made of mudstone, it exhibits wide but shallow notching and a slightly indented base. The right notch and the corresponding margin of the base have been ground. Workmanship is generally cruder than the previously described specimens.

Stem width, or the distance between the notches, averages 11.11 centimetres for the corner-notched specimens.

3. UNCLASSIFIED PROJECTILE POINT FRAGMENTS

Three projectile point fragments (Plates 1h-j) were recovered in excavation. Specimens 8 and 9 are made of burnt shale and brown chalcedony respectively. The former conforms closely in material and workmanship to the large corner-notched specimen, 3. The tip of the latter specimen exhibits rather crude workmanship, with a thick cross-section. It appears to have been heat-treated.

The third fragment, specimen 10 (Plate 1j), is very thin

and well worked, with flaking terminating at the midpoint. Made of mudstone, it represents a fragment of the body of a projectile point.

BIFACES AND BIFACE FRAGMENTS

A total of nine bifaces and biface fragments was recovered in excavations. Specimens 11 and 12 probably functioned as hafted knives (Plate 2a, b). The former is made of quartzite and is lanceolate in outline. Percussion flaking was the method of manufacture. The proximal end has been abruptly snapped off, perhaps at the junction with the haft. Extensive resharpening is also indicated. The latter specimen, made of mudstone, exhibits a rather fine bifacially worked edge along the right margin and a coarse sinuous edge along the remainder of the left margin. Both the distal and a portion of the proximal end have been broken off. The ventral surface is also fairly heavily patinated.

Specimen 13 is a large bi-pointed biface made of heavily-weathered mudstone. The tool still retains sharp sinuous cutting edges. A small portion of the distal end has been broken off, perhaps during resharpening (Plate 2c).

Specimen 14 and 15 (Plate 2d, e) are crude rectangular bifaces. The former, made of translucent white chalcedony, is lenticular in cross-section. Analysis of workshop detritus indicates that this tool was manufactured, used, and resharpened *in situ*.

The latter biface is made from a dark grey quartzite flake, and is plano-convex in cross-section. The left margin exhibits a sinuous bifacially worked cutting edge, while the right margin has

a unifacially worked scraping edge. This scraping edge also shows evidence of use-polish under microscopic examination.

The distal end of the tool has a straight edge which is bevelled towards the dorsal surface by percussion. This tool may have had multiple functions, serving as a knife, scraper, and perhaps as an adze blade.

Specimens 16 and 17 are biface tip fragments. Made of quartzite, both exhibit heavy grinding or wear along their margins (Plate 2f, g).

Specimen 18 (Plate 2h) is a biface body fragment made of mudstone. It is perhaps a fragment of specimen 13 (Plate 2c), which is a large bipointed biface.

Specimen 19/20 is a quartzite biface fragment reconstructed from two pieces (Plate 2i). The left margin exhibits a casually worked sinuous cutting edge, while the right margin and distal end are unifacially retouched forming a fine bevelled edge. This specimen is made on a large decortication flake with the cortex retained on the ventral surface and running to the working edge. Cutting and scraping functions are indicated for this tool, and the unifacially worked edge shows evidence of use-wear.

R. Bonnichsen, University of Maine, (personal communication) suggests that a quartzite tool edge which retains part of the cortex tends to be finer and perhaps sharper than those edged formed from the interior material of a cobble. This would also depend upon the nature and degree of weathering exhibited by the cobble. Those which have been stream-rounded and rolled tend to have a thinner, finer

weathered surface particularly if this stream action has been recent. Other cobbles which are found in many static gravel deposits may exhibit more pronounced weathering of the cortex, making such coarser material less efficient in terms of tool edges. In this latter case it would be disirable to utilize the harder interior material of the cobble to form the tool edge.

END SCRAPERS

End scrapers from the first occupation at Locality 2 of the Boss Hill Site can be divided into three categories. This division is based on general morphology and relates to the basic method of manufacture.

Category 1.

This group includes those tools that are plano-convex with steeply retouched worked edges. They are manufactured from black chert bipolar split pebbles. The pebble cortex is usally retained on the dorsal surface of the tool.

Two artifacts are included in this category, specimens 21 and 22. The latter exhibits a large heat-fracture on its dorsal surface (Plate 3a, b).

Category 2.

This group includes those tools made on blade-like flakes. They are roughly triangular in cross-section with steep lateral edges meeting to form a dorsal ridge. The ventral surface is generally flat. The distal ends are steeply retouched forming a convex working edge.

Included in this category are specimen 23, made of chalce-

dony, and specimens 24 and 25, made of chert (Plate 3c-e).

Category 3.

This category includes end scrapers with steeply retouched distal ends and roughly plano-convex cross-section. These tools were most likely manufactured from irregular waste or decortication flakes.

Specimen 26 is made of translucent chalcedony; specimen 27 is made of quartzite (Plate 3f, g).

End scrapers were probably hafted to either wood, bone, or antler handles and may have served a hide- or wood-working function similar to ethnographic examples known from the region. Unfortunately handles have not generally survived in the archeaological record. Since antler and bone are well preserved in the Boss Hill Site, perhaps the end scrapers represent disposable blades from antler-handled hide scrapers, or perhaps they had wooden handles which subsequently decomposed.

SPOKESHAVE/GRAVER

A single spokehsave/graver of chalcedony was found (specimen 28, Plate 3h), manufactured on a plano-convex flake. The steeply retouched concave right margin exhibits use-wear. Under microscopic examination, the chisel-like distal end also shows evidence of polishing indicating use-wear.

UNIFACIALLY RETOUCHED FLAKES

A total of 13 unifacially retouched flakes was recovered in excavation. Specimen 29 (Plate 4a) made of quartzite was made

on a cobble decortication flake with the cortex forming the convex dorsal surface. One quartzite example, specimen 30 (Plate 4b), is similar to specimen 29 but has the cortex surface forming the plane ventral surface of the tool.

Unifacially retouched flakes manufactured from bipolar split pebbles with cortex retained on the ventral surface are represented by two examples, specimens 31 and 32 (Plate 4c, d). The remaining tools were manufactured on secondary flakes which retained no cortex. Usually obtained as thinning flakes from the interior of cobbles, these tools exhibit fine unifacial marginal retouch. Several show evidence of successive sharpening as indicated by the pattern of step-fracturing. Specimens 33, 34, 35, and 36 are made of argillite; specimens 37, 38, and 39 are made of quartzite; and specimens 40 and 41 are made of mudstone (Plate 4e-m).

PIÈCES ESQUILLÉES

This group of artifacts is somewhat problematical with respect to classification. The specimens may represent discarded exhausted cores, or perhaps they were used as wedges. Flakes have been detached from both dorsal and ventral surfaces using the bipolar technique. The flakes thus detached were often modified into tools, but the production of the core to form a wedge may have been the main intent of the knapper.

These artifacts characteristically exhibit paired crushed and battered surfaces and are generally rectangular in outline. In MacDonald's discussion of this type of tool at the Debert site, Nova Scotia (MacDonald 1968: 85-90), he refers to them as "pièces

esquillées," and suggests that at no stage can they be considered finished. Through the phases of bipolar reduction, through use, they disintegrate until they reach a size which is difficult to hold, at which time they are discarded. The use of a hard hammer and anvil are prerequisites for their production, both of which are present in the first occupation at Boss Hill.

As to function, MacDonald (1968: 88) suggests they served primarily as wedges but secondarily as slotting tools. Thus, they would be associated with the groove and splinter technique for working bone, antler, ivory, or hard wood.

The antecedents of this type of tool go back far in antiquity. They were first recognized in Upper Palaeolithic assemblages in the Old World (MacDonald 1968: 85) and are present in many of the earliest Palaeo-Indian assemblages in North America, such as Debert, Bull Brook, Shoop, Holcombe, the Clovis levels at Blackwater Draw, and the Lindenmeier Folsom Site (MacDonald 1968: 89).

At the Boss Hill Site, this form persists through time at Locality 1. Pièces esquillées were recovered from stratigraphic units #1, #2, and #3 (Doll 1980: 32-33), which date from approximately 200 years to 4,800 years before present.

Four samples were excavated from the first occupation at Locality 2. Specimens 42 and 43 are made on black chert pebbles, while specimen 44 is made from a blocky fragment of quartzite (Plate 8a-c). Specimen 45 is a black chert bipolar pebble core with one large flake driven off the dorsal surface and three very small flakes removed from the ventral surface. No further modification is indica-

ted. Unlike the first three specimens, this example was probably not used as a wedge, since battering is confined to the dorsal end, while only slight bruising is present on the proximal end. This bruising is a result of a blow used to detach the single large flake from the dorsal surface (Plate 8d).

UTILIZED FLAKES

This class of tools comprises waste flakes the margins of which have been modified through use. This subsequent alteration is characterized by random flake removal, crushing, and grinding.

The most common type of waste flake utilized is that produced by splitting a chert pebble employing the bipolar technique. Eight bipolar utilized flakes were recognized. Included are specimens 46, 47, 48, 49, 50, 51, 52, and 53 (Plate 5a-g).

In addition, two decortication and three thinning flakes were utilized. The former category includes specimen 54, made of petrified wood, and specimen 55, made of quartzite. The latter category includes specimen 56, made of chalcedony, and a very large quartzite thinning flake reconstructed from fragments, specimen 57/58. The final example, specimen 59 is a large quartzite thinning flake exhibiting use-wear along its right margin (Plate 5h-l).

LARGE CHIPPED STONE TOOLS

This class follows that defined by Brumley (1975: 54) as heavy chipped stone tools, and includes large tools made on cobbles; all are of quartzite. This raw material was manipulated in basically three ways in order to produce finished tools. Three of the tools

were made by splitting cobbles roughly in half and subsequently retouching one or more of the edges. Here, as was the case with many of the small unifacially worked tools recovered from the first occupation, two choices were made with respect to the relationship between the retouched edge and the cortex of the cobble.

Two tools, specimens 60 and 61 (Plate 6a, b), incorporate the cobble cortex as part of the working edge. The cortex side of the cobble forms the ventral surface of the tools.

On specimen 62 (Plate 6c), on the other hand, the cortex forms the dorsal surface. The working edge is fashioned by retouching interior material of the cobble. The rationale behind these choices becomes very apparent upon examination of the tools. The first two tools were manufactured from well-rounded, and, in the case of specimen 60, highly polished cobbles. In addition, in my opinion most important, there is little or no chemical weathering on the surface.

Specimen 62, on the other hand, although exhibiting a well-rounded surface, is chemically weathered to a depth of up to .9 centimetres into the interior of the cobble. The inference is that incorporation of this weathered area would result in a less efficient cutting or scraping edge.

Specimen 60 has been retouched on three sides while specimen 60 is retouched along one. Both show evidence of repeated use and resharpening, perhaps indicating their efficiency for the tasks for which they were employed. Specimen 61, conversely, shows very little evidence of retouch and may have been a tool of expedience

only.

The four remaining tools (Plate 6d-g) were manufactured on large flakes rather than on split cobbles, representing the third method of manipulating the raw material. Specimen 63 has a single very flat, steeply retouched edge. It exhibits pronounced rehsarpening and use-wear. Specimen 64 has been retouched along the left margin and at the distal end. It is not as finely worked as the former specimen.

Specimens 65 and 66 are unifacially worked on alternate sides. These specimens, as all the heavy chipped stone tools, were manufactured and resharpened by percussion.

HAMMERSTONES

A total of four hammerstones was excavated. Specimen 67 (Plate 7a), of granite, is battered on all prominent edges and most flat surfaces. Specimen 68, of quartzite, exhibits the heaviest battering on the edges. Specimen 69, of quartzite, is battered mainly on the proximal and distal ends (Plate 7b, c).

Although these hammerstones may have been employed in a variety of tasks, my own replication experiments suggest that the largest example from Boss Hill could have been used for some of the coarser percussion flaking. In conjunction with an anvil, it could also have been used to split pebbles by the bipolar technique. Perhaps the smaller cylindrical hammerstone would have been more suitable for finer percussion work, where greater precision and less force were needed. The heavy concentration of pulverized bone in association with the hammer and anvil stones suggests their primary use

may have been in bone breaking as a preparation for the removal of bone grease.

Specimen 70 (Plate 7d) appears to be a fragment of a granite hammerstone, probably shattered through use. The dorsal surface of this tool is heavily battered.

Specimen 71 is a quartz cobble hammerstone. Battering is exhibited on all of the prominent ridges of the tool, but it is less pronounced on the flatter surfaces. A number of flakes have also been detached as a result of use. The coarseness of this material and the numerous cleavage planes would mitigate against its use as raw material from which to manufacture finely finished tools (Plate 7e).

ANVILS

Four cobbles that served as anvils were recovered during the course of excavation at Locality 2. Specimens 72 and 73, of quartzite and granite respectively, have peck marks on their dorsal surfaces (Plate 7f, g). In both instances, the pecked surfaces were upright, suggesting they had been left in place subsequent to their use as anvils.

The third example, specimen 74 (Plate 7h), has very slight evidence of pecking on its dorsal surface. It was excavated from the center of an area of bone-breaking activity where the long-bones of bison and wapiti were pulverized, apparently to facilitate the extraction of marrow. Used in this way, probably little modification of the anvil would result, given the plastic nature of green bone.

Specimen 75 is a large tabular core of coarse quartzite. Battering on the dorsal surface and its position in situ indicates use as an anvil (Plate 7i).

MILLING STONES

Two coarse-grained sandstone milling stones were excavated from the first occupation. Specimens 76 and 77 (Plate 7j, k) are generally plano-convex in cross-section.

They were most likely used to prepare seeds and other vegetable matter for food. Similar artifacts were also used to reduce small mammal bones, particularly those of rodents, to a paste for food, as is suggested for Early Plains Archaic sites in Wyoming (Frison 1978: 335).

BIPOLAR SPLIT PEBBLES

At the Boss Hill Site, five bipolar split pebbles were found. These artifacts represent the non-utilized or discarded portions of bipolar pebble cores or pièces esquillées. All specimens are made of chert. Included are specimens 78, 79, 80, 81, and 82 (Plate 8e-i). Specimen 80 exhibits evidence of heat treatment in the form of color change and pot-lid fracturing (Plate 8g).

LARGE CORES AND CORE FRAGMENTS

Considering the number of finished tools recovered from Locality 2, surprisingly few cores were found. The two largest specimens, 74 and 75, served as anvil stones and were classified as such (see page 53 and Plate 7h-i). The remaining five examples are difficult to relate to the finished tool assemblage. Specimen 83

(Plate 9a) is a tabular slab of quartz. Along the right margin is a cavity containing well developed quartz crystals surrounded by a matrix of translucent chalcedony. A number of flakes have been haphazardly detached. One biface in the assemblage is made of similar material (see Plate 2d).

Specimen 84 (Plate 9b) is a petrified wood core. A number of flakes have been detached from the dorsal and ventral surface of the distal end. The proximal end has been broken off perpendicular to the path of the detached flakes. Although the distal end exhibits heavy battering, not unlike that observed on chert bipolar pebble cores, proof of the use of bipolar percussion is lacking. The original proximal end of the core was not recovered in excavation.

Specimen 85, and two articulating flakes 86 and 87, form an irregular chert pebble when reassembled (Plate 9c). The specimen may have been tested for its tool-making suitability and subsequently discarded without further modification.

OCHRE

A piece of heat-treated clay-ironstone was recovered in excavation (Plate 9d). Portions of this specimen 88 exhibit a deep red color and produce an excellent stain. Pigment may have been derived from this specimen.

BONE TOOLS

Only one tool of bone was recovered from the first occupation of the Boss Hill Site. Specimen 89 (Plate 10a) is a heavily mineralized bone flake which has been extensively retouched

along one edge. There is evidence of use-wear and resharpening and this specimen too may have performed a scraping function.

ANTLER TOOLS

Specimen 90 (Plate 10b) is an antler tine most likely from wapiti. It was cut away from the main beam and the distal end exhibits use-polish. Due to extreme encrustation with calcium-carbonate-saturated clay, it is impossible to determine additional modification without destroying the tine. If the use-wear was the result of use by man, the tine may have functioned as a pressure flaker. Chomko (1975) has devised a classification scheme for antler tines based upon the presence of wear. The Boss Hill specimen is comparable in outline to "class 3" utilized tines (Chomko 1975: 36, fig. 7).

Specimens in this class generally have unmodified points with short deep perpendicular straiations. These specimens also exhibit a high polish on the proximal half of the tool (Chomko 1975: 38). Chomko (1975) does not, however, suggest a specific function related to this pattern of wear.

In summary, 90 portable artifacts were recovered from the first occupation of the Boss Hill Site, Locality 2. For the convenience of orderly description these were classified into 16 categories, many of which are functional. The variety of tool types is perhaps suggestive of several cultural activities having taken place at the site.

In general, lithic raw material was obtained locally from sources of glacial origin. However, exotic brown chalcedony may have been obtained from as far away as North Dakota.

The data evince the presence of a very general form of lithic technology utilizing the bipolar technique. With the exception of a biface, portable artifacts manufactured using this technique may represent the only tools made in situ. Chipping detritus indicates many other tools, particularly those employed in butchering and food processing were used and resharpened on the site. In addition there is a general paucity of decortication flakes on the site, while evidence for purposeful thermal modification of raw material may be fortuitous.

Stone working ability was highly developed; however, this was translated into a relatively small number of objects. The remaining artifact sample perhaps reflects varying degrees of expediency. The most aesthetic did not necessarily translate into the most efficient.

Lanceolate projectile points, generally characterized as belonging to the Palaeo-Indian stage of cultural development, were recovered in direct stratigraphic association with corner-notched points, normally thought indicative of the Archaic Period.

Lastly, these corner-notched points are recognized as a new type, Boss Hill Corner-Notched. Though morphologically similar to Mount Albion, the major distinctions are spatial and temporal as well as contextual.

BOTANICAL REMAINS

Perhaps the most useful and desirable data which can be used in interpreting palaeoenvironments are those derived from plant micro and macro-fossils. As much as time and resources allowed, field

and laboratory energy was devoted to the recovery of such data. A positive feature of this endeavor is reflected in the compilation of a list of modern-day plant species for the Buffalo Lake area. This is the result of combining data compiled by Dr. C.D. Bird for the southwest shore, and by Julie O. Hrapko from the northeast shore of Buffalo Lake. After reorganizing the data, I was able to have Hrapko annotate the list, indicating plants of known ethnobotanical and ethnopharmaceutical use (see Appendix I). These contemporary data were to form the basis for comparison with fossil material.

Mr. Keary Walde examined several samples from Boss Hill for the presence of fossil pollen. He found, at least in the case of the samples from Locality 2, that pollen grains were not well preserved. In addition, the deposits from which the samples were derived were extensively reworked, containing pre-Quarternary pollen (see Appendix VI). A core, approximately seven metres in length was taken from Buffalo Lake in March of 1982. The purpose was to recover a sedimentary record for microfossil analysis. Unfortunately, the results of the analysis will not be ready in time for inclusion in this study.

Soil conditions which may have mitigated against the preservation of pollen, have fortunately not destroyed silica phytolyths. Soil samples obtained from the site have been initially processed by Miguel Bombin of the University of Alberta. Although the identifications are yet to be completed, Bombin (personal communication) indicated that there were plant phytolyths present in the lower levels of the site.

Quantities of charcoal were recovered by flotation of fill from the living floor. A sample was given to Dr. John McAndrews of the Royal Ontario Museum. Identification of plant species was not possible due to the small size and the state of preservation of the pieces in the sample.

Only one plant species has been positively identified from the first occupation. This identification was based on a charred seed from a choke cherry, *Prunus virginiana*. Several other charred seed-like samples are presently undergoing identification in the Purity Laboratory of Agriculture Canada, Edmonton.

Although a number of palaeoecological avenues have been investigated, the paucity of reliable fossil data has mitigated against a strong case for environmental reconstruction.

Most published pollen studies in Alberta either deal with cores derived from lakes quite far removed from Buffalo Lake, such as Lichti-Federovich's research at Lofty Lake (1970), or lakes with too recent basal dates (Forbes and Hickman 1978). However, results from recently published research north of the Boss Hill Site may five some indication of general climatic changes which have taken place in late glacial-Holocene times (Schweger *et al*. 1981). In all, 17 lake sites were studied on an east to west transect through central Alberta, roughly 160 kilometres north of Buffalo Lake. This transect crosses several ecological zones including the southern Boreal Forest, the Parkland, and the Rocky Mountain Foothills (1980: 47, Table 1). Schweger *et al*. (1981: 42) found that most lakes in central Alberta were relatively young, and that not every one provided a continuous

sediment record extending back to the late glacial period. Of pertinence to this study, however, was the indication of significant early to mid-Holocene aridity. Studies suggest a drought interval of 3,400 years, between 9,200 and 5,800 years before present (Schweger et al. 1981: 54). In addition to a significant drop in water levels, a northward advancement of prairie vegetation is postulated. At Moore Lake in the modern southern Boreal Forest, for example, there are significant increases in Artemesia and Gramineae pollen frequencies with a coresponding decline in Picea percentages followed by restabilization of boreal vegetation after 5,800 years before present (1981: 56-58). Furthermore, in central and southern regions, modern vegetation and climate become established by 4,000 years before present (1981: 58).

Antevs (1955) has suggested, for the Central Plains, a period of drought lasting from approximately 7,500 to 5,000 years before present. In Colorado, Benedict (1979) proposed a two-drought Altithermal, the first, lasting from 7,000 to 6,500 years before present and the second, from 6,000 to 5,500 years before present. For central Alberta, Schweger et al. (1981: 58) suggest "that the period of significant drought began approximately 9,000 B.P. and continued until 6,000 B.P. at which time some lake basins began to infill."

FAUNAL REMAINS

Since the Buffalo Lake region presently supports a diversity of animal species, the author suggests that prehistoric peoples may have taken advantage of similarly rich resources. This hypotheses is

supported by evidence obtained from the faunal remains in the first confirmed occupation at Locality 2. Large mammal bones from this occupation were broken, presumably to obtain bone grease. Intentional breakage of small mammal and bird remains was also noted. A similar degree of breakage, with respect to large mammal remains, was noted at the Gowen Site of Early Plains Archaic age in Saskatchewan (E. Walker, University of Saskatchewan, personal communication).

Bone excavated from the first occupation was generally quite soft when first exposed, but once dried, became exceedingly hard, perhaps due to a degree of mineralization. Identification and determination of age, sex, and minimum numbers of individuals were hampered by the extensive fragmentation. Much laboratory time was, therefore, devoted to piecing together some of the larger bone fragments in order to facilitate identification.

The analysis of bison remains indicates the possibility of two species being represented. Comparison of proximal rib fragments to those of the largest skeleton at the Provincial Museum of Alberta indicated that a Boss Hill specimen was a much larger animal (Plate II). The Museum specimen was a male Wood Bison, four and one half years old. When collected it weighed 2076 pounds (944 kilograms).

The average weight of a mature Plains Bison some five or six years of age is about 1600 to 1800 pounds (Haines 1975: 165; Soper 1941: 376). However, there have been records of mature bulls weighing upwards of 3,000 pounds, especially in the case of Wood Bison (Park 1969; Roe 1970; Soper 1941). Although the evidence from Boss Hill is extremely tenuous, there may be a presence of

Bison bison athabascae, of which a minimum of one individual is represented. There is also historical evidence of the sighting of this species not too far away; for example, Wood Bison were noted by the fur trader Alexander Henry the Younger as being seen near Rocky Mountain House in 1810 (Coues 1897). There were also sightings just east of Edmonton (Roe 1970). It would be much too presumptuous, given the nature of the evidence, to suggest the presence of Bison occidentalis at the Boss Hill Site.

Additionally, four individuals of Bison bison bison were identified. Three were mature individuals while the fourth was immature.

The Boss Hill Site also produced the remains of wapiti, Cervus candensis. The identification of several longbone and antler fragments suggests at least one male individual.

An antler tine (Specimen 90), presumably from the same animal, was modified by detachment from the main beam and perhaps utilized as a tool.

Black bear, Ursus americanus, is represented by an extremely worn right maxillary canine tooth from a fairly old individual. Due to the lack of other elements of this species in the site, it is suggested that this tooth may have served as a personal ornament, rather than representing a food source at this particular campsite.

Smaller mammals are also well represented in the faunal assemblage. A canid, Canis sp., is represented by a lower premolar. In size and conformation, it is smaller than modern wolf, yet larger

than modern coyote. It may be from a domestic dog, Canis familiaris.

A left tibial tarsal from a kit or swift fox, Vulpes velox, was found. Since the burned bone of this species was recovered in direct association with a food processing feature, it is assumed that the fox served as a source of food.

A minimum of one individual of each of the following species was identified: badger, Taxidea taxus; beaver, Castor candensis; muskrat, Ondatra zibethicus; and jack rabbit, Lepus townsendii.

The most common remains were those of snowshoe hare, Lepus americanus. Several bones of this species were broken and many were burned. A minimum of three individuals were identified.

The washing and fine screening of earth fill excavated from hearth features resulted in the recovery of several rodent teeth. Species identified from these teeth include: pocket gopher, Thomomys talpoides; meadow vole, Microtus pennsylvanicus; and red-backed vole, Clethrionomys gapperi.

Avifauna were also recovered from the first occupation. Except for a few cases, positive identification was impossible. From the duck-sized bird bones, only two species could be identified. These were Blue-Winged Teal, Anas discors, and Lesser Scaup, Aythya affinia, accounting for one individual each.

Bones of geese were also found, including Snow Goose, Chen caerulesceus (one individual), and White-Fronted Goose, Anser albifrons (one individual). In addition one unidentified Goose, Family Anatidae, was found.

Fish were apparently utilized, as attested by the preserva-

tion of a vertebral centrum of indeterminant species associated with a hearth.

Several gastropod species were identified from the soil matrix of the first occupation at Locality 2, but there is no reason to assume they were utilized by man. Included were Gyvalus parvus (Say), Helisoma trevolvis (Say), Lymnaea caperata (Say), Lymnaea obrussa (Say), Physa anatina (Lea), and Promenetus exacuous (Say).

A sample of material from the shallow pond deposit below the first occupation was taken by Dr. Gerald Osborn and processed by Marueen Galligher of the University of Calgary. From this sample, a number of ostracods (small aquatic crustaceans) were identified. The following species were identified: Limnocythere ornata (Holocene), common to inland fresh-brackish-saline pools; Candona cf. angueata (Holocene), a freshwater mud burrower; and Candona rp. (Oligocene-Holocene) (Osborn, personal communication).

In summary, 28 animal species have been identified from reconstructed broken remains. Mammals (13 species) comprised almost half of this total. Bison represent the largest and voles the smallest species found.

All avifaunal species identified were those of waterfowl. Other species identified which required a nominal amount of water as habitat included one species of fish, several of the six species of gastropods, and three ostracod species.

The fossil osteological record at Boss Hill has been much better preserved than that of botanical remains. This record of many species, notably bear, fox, and voles may provide evidence

to facilitate partial ecological reconstruction at the Boss Hill Site.

DATING

The first occupation at Locality 2 of the Boss Hill Site is bracketed by two strata yielding chronological data.

The first stratum (Depositional Unit VIA, Figure 5), is a marly shallow pond deposit consisting mainly of clayey silt (Walde Appendix VI: Figure 1), carbonate concentrations, and organic material. Preserved plant material from this pond deposit was submitted for radiocarbon analysis, yielding a date of 8090 ± 310 years B.P. (Laboratory Number S-1483).

The second of these is a deposit of volcanic ash (Figure 5) located above the cultural deposit and separated from it by a sterile stratum (Depositional Unit IVC, Figure 5). A sample of this ash has been subjected to laboratory analysis by Pam Waters, a graduate student at the Department of Geology, University of Alberta. Waters (see Appendix II) determined the ash to be derived from the eruption of Mount Mazama (now Crater Lake in Oregon) which occurred approximately 6,600 years ago.

The two dated strata allow approximately 1490 years for the deposition of 120 centimetres above the pond deposit from which the basal date was obtained is the organically rich cultural deposit. From this deposit three additional radiocarbon dates were obtained (Figure 5 and Table 17). A determination of 7875 ± 130 years B.P. was obtained from bone (Laboratory No. S-1251), and 7750 ± 105 years B.P. was obtained from hearth charcoal (Laboratory No. S-1371).

Both these dates are consistent with those obtained from the strata above and below the cultural deposit. Within the cultural deposit, the two dates overlap within one standard deviation, and therefore are considered acceptable by the author.

The third date from the cultural layer was 6150 ± 95 years B.P. (Laboratory No. S-1250). This date is rejected as being inconsistent with the other data. There is a good possibility of contamination since the material submitted for radiocarbon analysis was obtained from several kilograms of fill. Charcoal, roots, and twigs which appeared to be charred were removed by flotation, and involved in a considerable amount of handling. The date is also entirely inconsistent with that of the volcanic ash deposit stratigraphically above it.

The dating of the first occupation at Locality 2 of the Boss Hill Site is considered by the author to be highly reliable and consistent with the nature of the stratigraphy.

CHAPTER V

ANALYSIS

COMPARISONS, THE PROJECTILE POINT TRADITIONS

The most diagnostic artifacts from the first occupation of the Boss Hill Site, Locality 2, are projectile points. These points reflect two basic technological traditions in the manufacture of stemmed-lanceolate and notched forms. Bryan (1980: 82) suggested:

> The technique of hafting was much more important than the overall projectile point form to the weapon maker, and therefore the shaping of the portion of the point to be hafted should be considered the primary basis for defining projectile point traditions.

Frison (1978: 85-90) has demonstrated that stemmed-lanceolate points could have been hafted efficiently in a socket; he does not rule out the possibility of hafting to a split shaft (Frison 1978: 333). The sinew bindings of the latter, however, were insufficient to maintain the point in the haft when used as a butchering tool. Notched projectile points appear to be better adapted to the split shaft. There is archaeological evidence to support the relatively great anitquity of both traditions, which are coeval at the Boss Hill Site.

1. THE LANCEOLATE POINT TRADITION

The earliest evidence for a stemmed-lanceolate projectile point technological tradition has been documented at Smith Creek Cave, Nevada (from the Mount Moriah occupation zone) radiocarbon dated at 11,680 ± 160 years B.P. (TX-1421) (Bryan 1977: 186). This technological tradition persists as part of the Shield Archaic in the

Northwest Territories of Canada until perhaps 950 years B.P. (Wright 1972) and in Alaska to within the last 3000 years (Workman 1974). The persistance of this technological tradition should not, however, be interpreted as a continuous cultural tradition.

In attempting to deal more with the overall form of the projectile points, Pettipas (1981) splits the lanceolate or Plano Tradition into three co-traditions. The "Niobrara" tradition, according to his scheme, includes Hell Gap, Agate Basin, and Mummy Cave lanceolate points. "Amarillo" includes Plainview, Meserve, and Frederick, while "Bayard" includes Alberta, Eden, and Scottsbluff. Pettipas' morphological approach implies cultural overtones which require more supporting data than presented in his paper.

Lanceolate projectile points which correspond most closely to the examples from Boss Hill are those of the Agate Basin type (Frison, personal communication). These are radiocarbon dated between 9,350 and 10,430 years B.P. at the Brewster and Agate Basin Sites in Wyoming (Frison 1978: 23).

In Canada, Agate Basin technology is well represented in surface collections from sites in Manitoba, Saskatchewan, and Alberta. The most widely known is the Parkhill Site (EbNj 4) located on the north edge of the Northern Plains near Moose Jaw, Saskatchewan (Figure 1). A large collection of lanceolate points was gathered from the surface of this site and described by Nero (1959) and subsequently analyzed by Ebell (1980). From a collection of over 300 artifacts, Ebell (1980: 4) identified 137 as Agate Basin points of bifaces.

Based on a conversation he had with Frank H.H. Roberts of the Smithsonian Institution, Nero (1959: 48) suggested a date of 7,000 to 8,000 years B.P. for the Parkhill lanceolate points. He also considered the existence of non-lanceolate points (notched) as "significant and indicative of Early Archaic relationships" (Nero 1959: 48).

On the basis of dates obtained from Northern Archaic sites and from the Agate Basin and Brewster Sites to the south, Ebell estimated a date of 8,000 to 8,500 years before present for the Parkhill Site. He suggests that "the northward movement of the Agate Basin complex appears to occur at the same rate as the northward recession of the Laurentide ice and the vegetational zones that followed it" (Ebell 1980: i). The data, however, suggest that these materials in the Parkland significantly post-date the glacial retreat.

Lanceolate projectile points of the Agate Basin technological tradition have been excavated from a few sites in or adjacent to the Plains/Parkland zone (Figure 1). In Manitoba, the Duck River Site, ElMb 10, produced four projectile points, two of which were recovered in situ (Haug 1981). In addition, one end scraper and several flakes, cores, and hammerstones were found. The site, however, lacked perishable remains and is undated.

In Northern Saskatchewan, S. Minni recovered a base of an Agate Basin type projectile point from IhNh 10 (Figure 1), a disturbed site (1976: 48). Again no dates were obtained.

In Alberta several excavated sites have produced lanceolate

points which I would attribute to the Agate Basin technological tradition. Three of these sites are located along valleys in the front ranges of the Rocky Mountains.

The Gap Site, DlPo 20, is located on the eastern edge of the Livingstone Range (Figures 1 and 2). A lanceolate point belonging to the Agate Basin type and an asymmetrical lanceolate-bipoint-type biface, both surface finds, were noted as probably coming from a living floor which produced a fragmented bison mandible, an articulating bison axis, first and second cervical vertebrae, and unidentifiable bone fragments (Reeves and Dormaar 1972: 332). The charred bison cervical vertebrae were radiocarbon dated at 9,520 ± 240 years B.P. (GX - 0956), while charcoal from the same floor was dated at 8,000 ± 150 years B.P. GAC - 1158 (Reeves and Dormaar 1972: 333).

Site DgPm 1 is located in Pass Creek Valley in the Lewis Range (Figures 1 and 2). Here, several artifacts including Lusk, Agate Basin, Lerma, and Scottsbluff projectile points, as well as several scrapers and flake tools, were recovered from a cultural level which had been disturbed by Cryoturbation (Reeves 1972: 93). However, a circular excavated-basin hearth, 30 centimetres in diameter and 20 centimetres deep, with charcoal stained fill, was discovered. Associated with this feature were three small post molds interpreted as being evidence for a wooden tripod. Charcoal from the hearth yielded a date of 8,220 ± 260 years B.P., GX - 1435 (Reeves and Dormaar 1972: 94).

Site EgPr 2 is located on a terrace overlooking Sibbald

Flats in the foothills west of Calgary, Alberta (Figures 1 and 2). Within a meager 45 centimetres of accumulated deposits, this site has produced perhaps the longest cultural sequence of any archaeological site in western Canada. Artifacts from the historic period back to fluted projectile points were recovered in apparently undisturbed stratigraphic context. Gryba (1981: 146) illustrates a sample of the Palaeo-Indian artifacts including those representing Agate Basin technology. Although no radiocarbon dates are available, the stratigraphic sequence of Palaeo-Indian material is of particular interest. Fluted projectile points were recovered from the bottom of the site, along with a point resembling Midland. Above these were found Agate Basin points and above these was found a Scottsbluff projectile point (Gryba, personal communication). I believe this sequence is important in the chronological and sequential interpretation of other sites on the Canadian Northern Plains. It also tends to support the hypothesis that users of fluted points were the first to occupy certain parts of Alberta probably in early postglacial times.

In northeastern Alberta two recently explored sites yielded lanceolate projectile points in the Agate Basin technological tradition (Stevenson 1981a, 1981b). The Peace Point Site and the Lake One Dune Site are situated in Wood Buffalo National Park (Figures 1 and 2). In the former, notched projectile points were found within deeply stratified deposits (Stevenson 1981b: Figure 2). To date, 15 cultural levels have been identified; however, a basal date of 2250 $\pm$ 153 years B.P. (Stevenson, personal communication) might

suggest Boreal Archaic rather than late Palaeo-Indian affinities.

At present, with respect to early lanceolate technology, there are no excavated sites with unquestionably reliable chronological data and artifact association on the Canadian Plains or Aspen Parkland other than the Boss Hill Site. As one moves farther northward, however, there are increasingly more data on the Agate Basin technological tradition.

The Grant Lake Site, KkLn 2, in the Keewatin District of the Northwest Territories, has produced a large assemblage of lanceolate projectile points from a number of habitation components located at a caribou interception point. Fishing may also have supplemented the food supply (Wright 1976: 82). Several disparate radiocarbon dates were obtained from the site, generally ranging from 160 ± 50 years B.P. (S - 833) to 3,620 ± 105 years B.P. (S - 810). Wright (1976) also cites one acceptable date of 7,220 ± 850 years B.P. (S - 1056) based on combined carbonized bone samples.

Gordon (1976: 47) has estimated dates for Agate Basin points in the Prairie Provinces to fall between 7,950 and 8,950 years B.P. and sites for northern versions of Agate Basin, or Northern Plano, between 7,950 and 6,950 years B.P. in the Northwest Territories.

The chronology from the Migod Site, KkLn 4, also on Grant Lake, places Early Shield Archaic material at 5,480 ± 120 years B.P. (GSC - 2152) suggesting an occupational hiatus of 1,700 years between Plano and Shield Archaic peoples (Gordon 1976: iv and 51).

Farther to the west, the Canyon Site, JfVg 1, in the southwest Yukon, yielded "Plano-derived points" associated with a hearth

dated at 7995 ± 100 years B.P. (Workman 1974: 101). Workman in quoting Haynes (1971: 6) suggests, however, that this date be adjusted backwards a millennium because of the noted long-term fluctuation of C-14 in the atomsphere. This particularly affects dates which fall between 6,000 and 7,000 which he sees as being 1,000 years too young. In general, however, as noted by Ebell (1980), dates on Agate Basin points tend to be more recent as one moves northward.

To the south, contemporaneous with the early occupation at the Boss Hill Site is one at the Betty Greene Site, located in Niobrara County near Lusk, Wyoming. Greene (1968: 70) recovered a series of lanceolate projectile points which she found comparable to those in the earliest levels of the Mummy Cave Site, also in Wyoming. Associated with the points were numberous end scrapers and flake tools. The pecking and grinding of stone tools was also well established as a manufacturing technique as represented by manos and metates (Greene 1968: 57-59, 71).

Two dates have been published for the Betty Greene Site: 6750 ± 800 years B.P. (1968: 64; no lab number given) and 7880 ± 430 years B.P., WSU - 670 (Frison 1978: 23). No explanation has been given for this disparity.

Although Greene does not suggest a typology for the lanceolate points from the Betty Greene Site, Frison (1978: 34) refers to them as belonging to the Lusk Complex, which is ther terminal Palaeo-Indian manifestation in southern Wyoming (see Irwin-Williams _et al_. 1973: 45).

The Mummy Cave Site in Northwestern Wyoming has produced

an archaeological sequence which has served the northwestern Plains and adjacent areas for many years. Controversy still exists over the interpretation of the final report; nevertheless, the stratigraphic and artifact descriptions are of value for comparative purposes.

A series of lanceolate projectile points from cultural layers 25 to 31 of Mummy Cave have been dates between 7,970 and 8,950 years B.P. (Husted 1978: 78-83). Those most comparable to the Boss Hill specimens were recovered from cultural levels 27 to 31 and date between 8,100 and 8,950 years B.P. (Husted 1978: 128, plate 61). This is also consistent with Ebell's suggestion (1980) of dates becoming more recent as one travels northward.

At Birch Creek, Idaho, in Site 10-CL-10, Swanson (1972: 91) has dated lanceolate points at 10,340 years B.P. He suggests that:

> the distribution of points which have been called by so many names is as great in space as it is in time. The occurrence of strikingly similar forms and broad collateral pressure flaking scars on both sides of the Rocky Mountains suggests that the type is a basic early form in the hunting of big game. Its occurrence with bison at Lind Coulee and at the Bison Rockshelter, plus a general association with lake and stream marshes, suggests the use of a spear to hunt large mammals at close quarters (Swanson 1972: 92).

2. THE NOTCHED POINT TRADITION

At the Boss Hill Site, Locality 2, lanceolate and notched projectile points are coeval in the first occupation. As far as I am aware this represents the earliest dated occurrence of

notched projectile points in the northern Plains/Parkland area, although they have been dated much earlier elsewhere.

As was the case with lanceolate point technology, there is substantial evidence for an early notched projectile point technological tradition. Gibson (1979) suggested two geographically isolated areas where there is evidence of notched point technology about 9,000 to 10,000 years ago. In Eastern North America, the St. Albans Site, West Virginia (Figure 1), produced side-notched points dated at 9850 ± 500 years B.P. (Broyles 1971).

Dates of similar antiquity were obtained from the Stanfield-Worley Shelter in Alabama (Figure 1), where there was also an association with Palaeo-Indian lanceolate points (Dejarnette et al. 1962: 85-87).

The Modoc Rock Shelter in Illinois (Figure 1) produced side-notched points below a stratum dated at 9872 ± 392 years B.P. with a suggestion that they may be older than 10,000 years B.P. (Fowler 1959).

Klippel (1971) noted that at Graham Cave (Figure 1), a lanceolate and side-notched point were also recovered in association in a stratum dated at 9700 ± 500 years B.P.

The Simonson Site, Iowa, (Figure 1) produced side-notched points in association with the remains of *Bison occidentalis*. A charcoal date of 8430 ± 520 years B.P. was obtained (Frankforter and Agogino 1960: 65).

Gibson (1979) has suggested the possibility of a separate western North American invention of a notched projectile point tech-

nological tradition. The earliest chronological evidence to support this suggestion was obtained from Danger Cave in Utah (Figure 1). A date of 9789 ± 630 years B.P. (C - 611) was obtained from level D 11, where small side-notched points were found (Jennings 1957: 104, 119). The reliability of this date, however, is somewhat doubtful, considering that a younger date of 8960 ± 340 years B.P. (C - 640) was obtained from an underlying stratum. Both side-notched and corner-notched projectile points were recovered as well as lanceolate points; however, they do not resemble the Boss Hill specimens.

Despite the discrepancy in the dates from Danger Cave, there is still good evidence to support a relatively early development of a notching technological tradition in the Great Basin. Hogup Cave, located north and east of Danger Cave (Figure 1), produced a series of corner- and side-notched points as well as lanceolate points of the Elko series. Recovered from the first four strata, these artifacts date from 7815 ± 350 years B.P. (BX 1287) in stratum four, to 8350 ± 160 years B.P. (GAK 1569) and 7860 ± 160 years B.P. (GAK 2086) in stratum one (Aikens 1970: 22-29). Associated milling stones, attributed to Desert Culture influences, were used for processing wild seeds.

Although Gibson (1979) argued for simultaneous independent invention of notched points in the Eastern Woodlands and the Great Basin, dates from sites such as St. Albans, Stanfield-Worley Shelter, Modoc Rock Shelter, Graham Cave, and Simonson certainly testify for the earlier manifestations in the East. Furthermore, based on evidence from at least two sites, it appears that notched point techno-

logy moved on to the Southern and South-Central Plains at a fairly early period. Wheat (1972: 158) suggests that Archaic facies represented by the appearance of notched points were evident at Blackwater Draw No. 1 (Figure 1), dated at 8470 ± 350 years B.P. (A - 512), and from the Pigeon Cliffs Site, dated at 8282 ± 100 years B.P. These dates are slightly earlier or approximately equivalent to the earliest reliably dated notched points in the Great Basin. In addition, Wheat (1972: 158) suggests that lanceolate points persist beyond this time on the Central and Northern Plains.

Farther North, the Pretty Creek Site, in Montana (Figure 1), had the earliest record of notched points, dated 7685 ± 580 years B.P. (UGa - 957) (Frison 1978: 41), until the discovery at Boss Hill. Similarly, Mummy Cave, in Wyoming (Figure 1), produced a series of side- and corner-notched projectile points in cultural layers 23 and 24 dated 7,630 years B.P. (Husted 1978: 76-77, 126, plate 59).

The age of the majority of sites producing early dates in the Central and Northern Plains may be typified by the chronology from the Hawken Site in Wyoming (Figure 1). Dates obtained from this kill site were 6470 ± 140 years B.P. (RL - 185) and 6270 ± 170 years B.P. (RL - 437) (Frison _et al_. 1976: 53) where _Bison occidentalis_ were identified.

Likewise, Gruhn (1961: 149) notes large notched or Northern Side-Notched points at Wilson Butte Cave, Idaho (Figure 1), at 6,450 years B.P.

In the midwest, Shay (1971) excavated a series of corner-notched and side-notched point components at the Itasca Bison Kill

Site (Figure 1). The time of occupation was estimated at between 7,000 and 8,000 years B.P., based on a series of ten radiocarbon dates from his pollen profile. Most of Shay's comparisons were drawn from sites to the south and east of Itasca (Simonson, Logan Creek, Graham Cave, and Modoc Rock Shelter) which certainly appear to be ancestral to the Itasca material.

Very similar to the Itasca side-notched material were projectile points recovered from the Gowen Site near Saskatoon, Saskatchewan (Figure 1). Dates of 6065 $\pm$ 200 years B.P. (S-1488), 6150 $\pm$ 110 years B.P. (S-1457) and 5760 $\pm$ 135 years B.P. (S-1448) were obtained on burned bone, charcoal and unburned bone (Schroedl and Walker 1978: 2).

In Alberta, the Gap Site, DlPo 20 (Figures 1 and 2) produced two early side-notched (Bitterroot) projectile points, one dated at 6060 $\pm$ 140 years B.P. (BSC - 1255), above a layer of Mazama ash (Reeves and Dormaar 1972: 333).

In the Cypress Hills, Southeast Alberta, Gryba (1975: 133) obtained a date of 7245 $\pm$ 255 years B.P. (NMC - 571) on Bitterroot side notched points from culture layer 12 A of the Stampede site, DjOn 26 (Figures 1 and 2).

Nearby, Bryan (University of Alberta, personal communication) may also have found notched material at a fairly early level of the East Battle Creek Site, DjOm 18 (Figures 1 and 2). A date of 7300 $\pm$ 150 years B.P. (GAK - 2334) was obtained at stream level approximately 4.5 metres below surface, but not directly associated with the projectile point bearing stratum.

It appears, therefore, that the notched points from the

lowest confirmed occupation of the Boss Hill Site Locality 2 are the earliest from the Northern Plains, with dates of 7875 ± 130 years B.P. (S - 1251) and 7750 ± 105 years B.P. (S - 1371). With this situation in mind, it is very difficult to make pertinent comparisons with probable ancestral assemblages, since none appear to exist within a reasonable distance. In terms of general morphology, however, the corner notched specimens from Boss Hill are similar to those of Archaic age from the Eastern Woodlands of the United States.

Likewise, there are exceedingly close similarities between Boss Hill materials and those attributed to the Shield Archaic (see Wright 1972 and Gordon 1976). This similarity is reinforced by the fact that lanceolate and corner notched projectile points are coeval in both assemblages as well as by similarities of other tool types. The Boss Hill material, however, predates these more nrothern assem - blages by more than 2,500 years.

Lanceolate and notched projectile points do not appear coeval in southwest Yukon and Alaska. Both forms in these areas also postdate Boss Hill. As discussed earlier in this report, lanceolate points are dated from the Canyon Site, Yukon (Figure 1) at 7995 ± 100 years B.P. (Workman 1974: 101) and from Fisherman Lake and Acasta Lake, N.W.T. between 6950 and 4950 years B.P., while in other Alaskan sites they occur within the last 3000 years (Workman 1978: 201-205). As to the origins of the lanceolate points, Workman (1978: 205) states:

> On balance I am inclined to stress connections with the increasingly well-documented Plano penetration of the Northwest Territories on an appropriately early time level, reserving

> final judgement pending enlargement of the sample . . . The Alaska examples, if truly related, are more likely to be descended from than ancestoral to the Southwest Yukon forms.

It is noteworthy that dates for the early occurrence of notched forms follow closely on the heels of the dates for lanceolate forms and in some cases overlap with them. At Anaktuvuk Pass there is a date of 6510 $\pm$ 600 years B.P., and there is a date of 5850 $\pm$ years B.P. on Northern Archaic material from Onion Portage (Workman 1978: 426). In discussing the northern notched forms Workman (1978: 428) states:

> It seems to me that the most plauseable point of origin for the intrusive Northern Archaic technology in Alaska is the northern plains, where side-notched projectile weapons have a long history. . . It appears that population movement rather than diffusion of ideas is required to explain its abrupt appearance, although the humans that carried this technology to Alaska need not have been of the same language stock as the largely hypothetical originators on the northern Plains.

To the south along the Rocky Mountain front range in Colorado, corner-notched projectile points most like the specimens from Boss Hill have been collected and excavated from several sites. These points share common outlines as well as similar degrees of modification and methods of manufacture, as discussed in detail in Chapter IV. But again these Colorado examples, attributed to the Mount Albion Complex, significantly post-date the Boss Hill materials. Dates obtained include 5800 $\pm$ 125 years B.P. to 5520 $\pm$ 190 years B.P. from the Hungry Whistler Site, and 5650 $\pm$ 130 years B.P. from Site 5BL70 (Benedict and Olsen 1978: 73, 115).

3. COEVAL TRADITIONS

In the Southern Plains, however, there is increasingly more evidence of both technological traditions dating from relatively early times. The corner-notched forms have been termed "Pre-Archaic" and have been recovered from at least thirteen sites (Figure 1: numbers 46-58). Coeval with the corner-notched points with expanding stems were thin lanceolate points of the Angostura type (Sollberger and Hester 1972: 329).

In addition to the theoretical implications of these finds in Texas, which are discussed in the introduction of this report, there are remarkable similarities technologically, chronologically, and perhaps ecologically between the situation and materials from Texas, on the southeast periphery of the Plains, and those from Boss Hill on the northwest periphery of the Plains (see Sollberger and Hester 1972). Technological and perhaps chronological similarities to the Pre-Archaic in Texas are exemplified by archaeological sites which are within reasonable proximity to the Boss Hill Site.

The Fletcher Site, DjOw 1, is located in southeast Alberta (Figures 1 and 2), about 32 kilometres south of the Oldman River.

This bison kill site consists of a buried bone bed exposed along the edge of a waterhole (Forbis 1968: 1). The artifacts consisted almost entirely of projectile points and tools useful in skinning and butchering large animals. The majority of the projectile points were lanceolate, Palaeo-Indian Alberta and Scottsbluff types. However, of specific relevance was the finding of a corner-

notched specimen (Forbis 1968: Figure 1-0). Forbis (1968: 5) states:

> There is nothing to suggest that the point has been relocated, and the probability remains that the specimen belongs to the bone bed and is, therefore, associated with Alberta points. Deep weathering of the material suggest antiquity. The chipping technique appears the equal of that employed in the manufacture of Scottsbluff and Alberta points; in fact, except for smaller size, it bears a resemblance to one point from the Scottsbluff Bison Quarry, Nebraska.

Geological interpretation of the Fletcher Site suggested a date from 10,000 or 11,000 years B.P., prior to the onset of the Altithermal 7,000 years ago (Forbis 1968: 2). (Note that Schweger et al. 1981 suggest a date of 9000 years B.P. for the onset of the Altithermal.) Quigg (1976: 108) subsequently returned to the Fletcher Site and obtained a radiocarbon date of 7655 ± 110 years B.P. (S - 1084) from level 12.

Although the results of pollen analysis were not conclusive, there appeared to be no substantial difference from the present flora represented through the sequence leading Forbis to suggest a prairie grassland as at present (1968: 2). Although a grooved maul (Forbis 1968: Figure 21) was found, Forbis does not consider the possibility of its use as a food-grinding implement.

Based on evidence from the Fletcher Site, Forbis (1968: 8) stated:

> My feeling is that on the northern short-grass Plains of North America, the term "Archaic", whether modified by qualifying adjectives or note, is not applicable.

Forbis (1968: 8) defined the Archaic as a cultural stage

in which native populations were:

(1) relatively sedentary, often living in caves or rockshelters;
(2) closely adapted to confined geographic territory, and
(3) economically dependent upon a variety of resources as they became available on a seasonal basis. It is presumably during certain periods in the seasonal round that food-grinding tools were used.

In using his definition of Archaic, Forbis (1968: 8) therefore, suggests that: "The Fletcher Site can in no sense be considered a manifestation of this stage or, for that matter, of the Protoarchaic."

Forbis (1968: 19) does go on to concede, however, that: "There is no need to dispute the validity of the Protoarchaic concept for many other parts of North America at the time level when Scottsbluff and Alberta points were characteristic of the Great Plains." The Fletcher Site is, therefore, interpreted as strictly a Palaeo-Indian bison hunting site.

The interpretation of the Fletcher Site should perhaps be re-evaluated particularly in light of more recent evidence. Most certainly, the definition of the "Archaic" appears to be the root of the problem. Mayer-Oakes (1960) dealt with the concept of the Plains Archaic at length. He summarized (1960: 580-581) that the term has "come to connote not only stages of culture and time periods but actual cultural inventories."

The current usage of the term, and one more or less followed in this study conceptualizes the Archaic as a convenient chronological period which is open-ended in order to accommodate new data as it is generated (Wright, National Museum of Man, personal communication). Factors such as cultural inventories and develop-

mental stages must still be considered, however. The Pre-Archaic as defined by Sollberger and Hester (1972) is outlined in Chapter 1 of this study. In light of data from the Alberta Parkland, the Pre-Archaic may be defined as the period of transition between the late Palaeo-Indian period and the beginning of the Early Plains Archaic period. It occurs after the onset of Altithermal and is characterized by the coeval occurrence of lanceolate projectile points of late Palaeo-Indian affinity and notched projectile points of Archaic affinity. The subsistance strategy of Pre-Archaic peoples is adapted to ecological diveristy; a major characteristic of the Aspen Parkland. Thus, the Pre-Archaic is a chronological period, but, one marked with cultural and ecological implications.

Forbis' contention that the lanceolate and notched points were coeval at the Fletcher site is reinforced by similar evidence at the Renier Site (Mason and Irwin 1960). That the Fletcher Site may represent a Pre-Archaic manifestation on the Northwestern Plains is supported by the following: Quigg's (1976) radiocarbon dates from the site showing it to be more recent than originally thought; ecological data showing an earlier beginning for the Altithermal (Schweger et al. 1981); stratigraphic data from the Sibbald Flats Site (Gryba, personal communication) which shows Scottsbluff points at the end of the lanceolate sequence; and lastly, the data from the Boss Hill Site.

The Fullerton Site, FfPi 1 (Figure 1 and 2) located in the Peace Hills, just outside the city of Wetaskiwin in central Alberta, has produced a sequence of prehistoric occupations very similar to those at the Boss Hill Site. Five distinctive corner-

notched projectile points comparable in style, material, and workmanship were recovered from level G, the earliest cultural level of the Fullerton Site. Through the kind permission of Mr. Fraser Taylor and Dr. Alan Bryan, the corner-notched specimens type 3a from the Fullerton Site are reproduced here (Plate 12).

Taylor (1969: 41-44) refers to these as "corner notched type 3a" (note an error in Taylor 1969: 44. The sentence should read 5 points no 1 point, from level G). In addition, one projectile point base from level F was also classified as type 3a. In attempting a comparative analysis, Taylor (1968: 111, 127) suggested a lack of comparable material to the Fullerton artifacts, stating that these corner-notched points were an "unknown entity" and of "unknown relationship".

Associated with these corner-notched points in level G were four lanceolate points; two "Plainview-like" and two Scottsbluff points (Taylor 1968: 38-41). Taylor (1969: 109) suggests an occupation date for level G approximately 6,000 to 10,000 years ago; however, no radiocarbon analysis has been attempted.

Similar distinctive corner-notched projectile points (Boss Hill Corner-Notched) were also recovered from the Gwynne Tower Site, FgPh 1 (Figures 1 and 2), located approximately 15 kilometres northeast of the Fullerton Site. Collected by Mr. Olaf G. Rasmusson of Gwynne, these points are illustrated on Plate 13.

Several sites in the Drayton Valley area, 100 kilometres southwest of Edmonton (Figures 1 and 2), also produced these distinctive corner-notched points (Plate 14). In all cases, surface finds

of Palaeo-Indian lanceolate forms were found in close proximity to these corner-notched forms. In my opinion this indirect association is not fortuitous, despite the fact that these finds were from the surface.

Evidence from the Boss Hill, Fullerton, and Fletcher Sites implies the possibility that the two projectile point forms are associated in these surface locations as well. In the cases of Gwynne Tower and the Drayton Valley area stratigraphic control has been destroyed through cultivation and subsequent erosion. The same was true of some of the sites in Texas used in discussion of "pre-Archaic manifestation" there (Sollberger and Hester 1972).

4. SUMMARY

The first occupation at the Boss Hill Site represents a group of hunters and gatherers who brought with them two technological traditions. The first of these traditions included the manufacture and use of lanceolate projectile points adapted to socket hafting (a technology suggested by Bryan 1980). This technological tradition may have originated in the Great Basin at least 11,700 years B.P. (Bryan 1977). A group of hunters who developed a specific lanceolate projectile points type, known as Agate Basin, have been documented on the HIgh Plains by 10,430 years B.P. (Frison 1978). The knowledge of this technology appears to have moved northward with Palaeo-Indian hunters shortly thereafter (Ebell 1980). Similar specimens are represented at Boss Hill.

The second technological tradition developed in the Eastern Woodlands about 9,850 years B.P. (Broyles 1971). It involved the

manufacture of notched projectile points which, as suggested by Bryan (1980), were adapted to split-shaft hafting. This technology, which may incidently have been independently invented in the Great Basin during the same time period (Gibson, 1979), appears to have moved on to the southern periphery of the Plains about 8,200 to 8,400 years B.P. (Wheat, 1972) and on to the Northern Plains by 7,685 years B.P. (Frison, 1978).

Boss Hill corner-notched projectile points predate all other known occurrences of notched points on the Plains and in the Aspen Parkland. Stylistically Boss Hill corner-notched points resemble Mount Albion Corner-Notched Points (Benedict and Olson 1978) but differ spatially, temporally, and contextually. Finally, there are at least two excavated sites and several surface sites in Alberta which appear to reflect the same coeval manifestations as those at Boss Hill.

THE BOSS HILL SITE: A SUMMARY ANALYSIS

1. DEPOSITIONAL ANALYSIS

The physiography and stratigraphy of the Boss Hill Site have been discussed in Chapters II and IV. The upper 3.32 metres of a recorded 6 metre profile have been excavated by hand. Based upon radiocarbon dates and a geological horizon marker it appears that this portion of the profile has been deposited within the past 9,000 years.

The first occupation at Locality 2 appears to be confined to a small basin no larger than, perhaps, 20 metres in diameter. The

presence of botanical remains and those gastropods and ostracods, coupled with the high concentration of carbonates (Figure 5) in the lower 1.3 metres of the profile, would suggest that a pond basin was chosen as a habitation site. The presence of both aquatic and terrestrial gastropods throughout this portion of the soil profile, and the type of soil development itself, is suggestive of a small meltwater catch basin, which, soon after filling, would become brackish, as evinced by certain ostracod species. This meltwater basin would eventually dry as the season wore on and provide a suitable camp location. Ther periphery of this basin may have been vegetated with Salix. If this were the case, additional shelter and fuel would have been supplied, perhaps explaining the quantities of burned twigs recovered from in and around the hearth features (Figure 4).

The inhabited pond basin collected colluvium from the east facing slope of Boss Hill over a period of several hundred years. The fact that several cultural features remained intact would suggest in situ burial rather than redeposition of cultural material from upslope.

The preservation of archaeological remains in situ is dependent upon a number of factors, not the least of which is rapid burial. This is particularly critical to prevent bone from being destroyed or dispersed by scavengers (Albanese 1978). Reconstruction of bone in the laboratory after excavation has demonstrated that scavengers were not a factor at Boss Hill.

Therefore, in summary, the following scenario is proposed

for the Boss Hill Site. Ecological evidence (see the following section) is used to determine that the occupation took place in late summer or early fall. In all probability, given the nature of the terrain, the site would have been inundated by meltwater the following spring. Soil would also be transported from the east slope of Boss Hill and deposited in this small natural catch basin. The very shape of the basin, in turn, would prevent the dispersal of the cultural material it contained. Additionally, periods of stabilizing vegetation could account for the numerous poorly developed A horizons evident throughout the soil profile above the first occupation (see Figure 5). Such stabilization would free much less soil from Boss Hill to be redeposited downslope. The combination of two basic factors, then accounts for the physical preservation of the Boss Hill Site: its location at the base of a hill, in this case a moraine plateau, and its location within a catch basin. Both factors seemed to have greatly enhanced the chances of rapid burial, containment of cultural material, and preservation. Finally, the site fluctuated between wet and dry conditions during the Altithermal as evinced by the formation of calcium-carbonate-concretion with a gleysol.

2. ECOLOGICAL ANALYSIS

King and Graham (1981: 133) suggest that the distribution of animals is primarily determined either by the distribution of plant food on which they depend, or the distribution of prey species so controlled. Likewise, when viewed as predators, it is reasonable to assume that the settlement patterns of prehistoric hunters

would be similarly influenced. Although the palaeobotanical evidence collected at Buffalo Lake is, at best, inconclusive, the faunal remains from the Boss Hill Site are useful in a general ecological reconstruction. The faunal remains from the first occupation show a utilization of a diversity of animal species as food approximately 8,000 years B.P. In turn this diversity is highly suggestive of the animal and plant community which may have existed in the Buffalo Lake region at the time. Animals such as Vulpes velox are normally confined to the drier prairies and semi-arid shortgrass plains. They have been known to range into the southern section of the Aspen Parkland transition zone. Buffalo Lake, however, appears to have been the northern extent of their range in historic times (Soper 1964: 274-275).

The archaeological evidence suggests that Vulpes velox was consumed as food at the site, and was probably procured within a reasonable distance. Egoscue (1979: 122), in referring to discoveries in cave deposits stresses "the potential importance of Vulpes velox as an indicator species identifying the former extent of short-grass and mixed-grass prairies."

On the other hand, the archaeological record appears to contain conflicting "indicator species." Also used as food were Castor canadensis and Ondatra zibethicus, both aquatic rodents. The former modifies its aquatic habitat through dam construction, thereby also creating suitable habitat for the latter, in addition to waterfowl and moose (Losey 1977: 40). Castor canadensis normally requires willow, aspen, poplar, or birch, while Ondatra zibethicus requires an abundance of aquatic vegetation normally

found along weedy lakes, ponds, sloughs, or marshes (Soper 1964: 179-180, 234). Both are common to the Aspen Parkland.

Bison bison and *Cervus candensis* were also hunted and consumed. The representation of most elements suggests that they were killed nearby. Both species require grasses as forage. Sources can be found either on the prairies, or along the edges of the Parkland and mixed-wood forests (Soper 1964: 339-342). *Cervus canadensis*, particularly, prefers grass ranges in summer, while sedge sprouts are eaten in the spring and fall, as grasses have died (Murie 1951: 199, 204). Both species tend to move from the prairie into the Aspen Parkland in fall and range there during the winter (Losey 1977: 31-36).

Lepus americanus is distributed throughout the Aspen Parkland, and requires timbered tracts as habitat. *Lepus townsendii* on the other hand favors treeless plains and prairies as its habitat (Soper 1964: 109, 112). Both species were in evidence as a food source. The main factor in their availability as a food resource appears to be the ten year population cycle phenomenon (Losey 1977: 37).

The presence of several waterfowl species and of fish certainly reinforces evidence of an environment conducive to aquatic species.

Other species recovered from the first occupation also appear to present an ecologically confusing picture. *Microtus pensylvanicus* inhabits meadows and fields and, especially, grassy places, usually preferring open places (Bailey 1900: 16; Soper

1964: 220). On the other hand Clethrionomys gapperi prefers forested or bushy habitats (Soper 1964: 206). Thomomys talpoides is chiefly confined to the parklands. Its habitat is also identified with the presence of black, loamy soils (Soper 1964: 167).

The diversity of species represented by the faunal remains from the first occupation at the Boss Hill Site indicates, at least superficially, that there existed a similar diversity of preferred habitats. What kind of habitat could have supported such diversity?

It would appear that the Boss Hill Site was situated on an eco-systemic border. The tendency for more variety and density at these borders, called "edge effect" (Odum 1959), has been stressed by Hickey (1974: 89) in his discussion of the northern forest edge in relation to the evolution and spread of past northern cultures.

That this pehnomenon exists in the more southerly counterpart, the prairie-forest transition zone, has been supported by Losey's (1977) more detailed study. In summarizing his data, Losey (1977: 193 in quoting Horn 1974) suggests that "diversity is one of the major characteristics of the prairie-forest transition." This diversity accrues from two fundamental sources:

> the interdigitation of communities representative of ecosystems flanking the transition will provide a greater variety along a given transect than a similar transect within these ecosystems. Second, disturbance brought about by a number of natural agencies such as fire, animal activity (grazing, browsing, etc.), and climatic fluctuations will, except in very immature ecosystems, allow successional species either to increase if they are rare, or to invade thereby causing an increase in diversity (Losey 1977: 103-184).

The present ecological nature of the Buffalo Lake area, as part of the Aspen Parkland (see Chapter II), serves as an example in

which the habitat requirements of most species in the archaeological record can be accommodated. Since the Aspen Parkland is characterized by both open meadows and wooded areas, species with divergent habitat needs can be accommodated. This can explain, for example, the co-existence of both *Microtus pensylvanicus* and *Clethrionomys gapperi*. Although *Bison bison* and *Cervus canadensis* inhabit the prairie-grassland, both winter in the Aspen-Parkland. Boss Hill may have provided an excellent denning area for the prairie species *Vulpes velox* as it does for similar animals today. Although the evidence is more tenuous, the Buffalo Lake area may also have been covered by enough forest to support *Ursus americanus*. In addition, the availability of sufficient water to support fish and a number of diverse awuatic birds and mammals in turn is suggestive of vegetation common to the Aspen Parkland, particularly aspen, willow, and birch.

Though not absolutely conclusive, the data from the first occupation of the Boss Hill Site, Locality 2, are highly suggestive of a parkland or a prairie-forest transition zone approximately 8,000 years B.P. Seasonality of the first occupation can perhaps be determined using the same body of data. Losey (1977: 153) was able to determine that his Low Water Lake Site in the Aspen Parkland was occupied during the late fall. This was based upon the identification of three mammalian species, which, because of their mutual seasonal availability, suggested the time of year. Losey made use of historic fur traders records in concluding that the co-occurrence of the species (bison, moose, and wapiti) would most likely take place in October (Losey 1977: 153).

A similar co-occurrence took place at Buffalo Lake were Bison and Cervus were found. A fall, perhaps October, occupation for the Boss Hill Site is reinforced by the faunal remains of several species of waterfowl. As discussed in Chapter II, Buffalo Lake and the surrounding lakes and ponds serve as a staging area for migratory waterfowl in the fall. Losey (1977: 153) notes a similar situation at Low Water Lake.

In addition, there are other species similarities between Low Water Lake and Buffalo Lake which reinforce the argument for a fall occupation. Both share aquatic rodents such as *Castor canadensis* and *Ondatra zibethicus* which, according to Losey (1977: 33), "if desired for their pelts or for food would be in prime condition in late fall." Fish remains, though rare in both sites, may indicate fall fishing, an activity supported in Losey's historical reconstruction (Losey 1977: 153). Finally, the presence of a mature charred seed of *Prunus virginiana* is botanical evidence to support the contention of late summer to fall occupation of the Boss Hill Site.

Evidence of the food quest is the best represented among the archaeological remains at Boss Hill. The variety of the animal species which were found has been discussed in this study. The use made of specific species is more speculative. Small mammals and birds were perhaps immediately consumed. The presence of large mammal remains, particularly those of *Cervus canadensis* and *Bison sp.* might suggest the preservation and storage of meat for later consumption. There is some contextual support for this assumption in the archaeological record. The remains of these species were

found associated with hearths and with anvils, hammerstones, bifaces and large chipped stone tools (Figure 4). Judging from tool wear the the presence of resharpening flakes, some butchering of these animals was performed in situ. Subsequently the longbones were pulverized, a process generally associated with bone grease extraction.

Evidence for the consumption of vegetable food is more circumstantial; the identification of a seed of Prunus virginiana being the sole example to date. The presence of grinding stones in the assemblage, by inference, suggests plants played a role in the diet of the prehistoric inhabitants. In addition, as many as 25 species of food plants may have been present if Hrapko's ethnographic analog were applied to the area (see Appendix I).

3. TECHNOLOGICAL ANALYSIS

The technological record is best preserved in stone at the Boss Hill Site. Traditional stone working is represented by bipolar pebble reduction employing a technique recognized in many of the earliest assemblages in North America (MacDonald 1968). Innovative stone work is perhaps best represented by the projectile points, which are the most temporally sensitive stone tools in the assemblage.

At the Boss Hill Site, bifaces and projectile points indicated the high degree of craftsmanship of the inhabitants. This was balanced by a number of tools exhibiting less refined workmanship, though, no doubt, these tools were equally as efficient for their intended tasks. The variety of tool types recovered is indica-

tive of the assortment of those tasks performed at the site.

The projectile points recovered may provide evidence for the employment of two basic weapon systems. The first, as suggested by lanceolate points, is the hand-held spear (see Swanson 1972). These points may have been hafted directly to a main shaft, or alternately, they may have been part of a more complex device. Recent experiments by Frison (1974 and 1978) and some by the author, have replicated a compound weapon system of which there was precedence in the archaeological record (see Gunnerson 1969: Figure 41). It consists of a projectile point hafted to a short foreshaft which is tapered at the proximal end. On the distal end of a much larger main shaft, a socket was constructed to accept the foreshaft. It had an advantage over the hand-held spear for it allowed the user to rearm his weapon readily. A hunter needed to carry only one main shaft with several prepared foreshafts and attached projectile points, an obvious weight reduction over carrying several spears. In addition, the projectile points, once hafted in the short foreshaft could be used to perform several other functions including perhaps, skinning, scraping, or as a close combat weapon. Similar points from the Park Hill Site exhibited burination (Ebell 1980), perhaps initially as a result of accidental breakage, though subsequently they appear to be perhaps used for working wood, bone, or antler.

Corner- and side-notched projectile points may be indicative of the use of th atlatl and dart (Gibson 1979). As in the system previously described, the point may have been hafted directly

to the dart or to a short foreshaft (Frison 1978: 223-224; Gunnerson 1969: Figure 41). This weapon system had the advantage of accuracy over a greater range, particularly advantageous when hunting wary or dangerous game. Most probably the use of the atlatl with the dart tipped with notched points had been perfected much earlier in the eastern woodlands for the hunting of deer. The environmental variety in terms of flora and fauna, as suggested by the parkland at Buffalo Lake would, likewise, tend to be exploited in a variety of ways. One would expect, therefore, to have this variety reflected in a group's subsistance technology.

In addition to the atlatl and dart, other missile weapons may have been employed, however, equipment such as bolas and slings are rarely preserved in any event. Their use has been documented as particularly effective in the hunting of ducks and other large birds (Stone 1934). It is probably, however, that self-acting weapon systems such as traps and snares were used, as there is evidence for their employment in adjacent areas at about the same period of time (Frison 1978). Such systems, however, would have been employed peripherally to the habitation site.

Although there were a number of lithic tools related to weapon systems, the assemblage was dominated by tools which served other functions. There were tools to make tools, food processing tools, and residually, multi-functional tools. Hammerstones, anvils, wedges, and the antler tine probably served to manufacture and maintain other tools. Additionally, there is evidence to suggest the use of the first two types for pulverizing longbones in

preparation for marrow extraction.

Most of the remaining categories of tools could have been employed in the processing of food and the manufacture of clothing. Bifaces, retouched flakes, and utilized flakes may be used for skinning and butchering, and heavy chipped stone tools for chopping. The end scrapers and other flake tools may have been employed in hide preparation. Grinding stones were most likely employed for the processing vegetable foods or the reduction of small mammal bones to edible paste (Frison 1978: 355).

Approximately 80 percent of the raw material used in manufacturing finished tools was available in local glacial deposits. Since it was easily available near the surface, little if any mining or quarrying was required. Materials such as mudstone and burned shale, of which 10.59 percent of the tool assemblage is made, may have required quarrying in order to obtain workable raw material. I have noticed that this material is particularly susceptible to desiccation and weathering when exposed. As with some varieties of chalcedony, buried mudstone and burned shale tend to have better knapping properties than similar material exposed to the elements.

The majority of the finished tools were not manufactured on the site. Except for the resharpening of existing tools, and the manufacture of a few pebble tools using the bipolar reduction technique, tools were apparently manufactured elsewhere or from blanks elsewhere. Very few decortication flakes were found on the site.

With the exceptions of a bone and an antler tool, and the

use of fire, there is almost no evidence of non-lithic technology preserved at the Boss Hill Site. That the hunters and gatherers who occupied the site were mobile can be inferred from the nature of the archaeological remains. They were pedestrian as well. There is attenuated evidence for the presence of a dog at the site. The earliest evidence for dog in Alberta is from the Crowsnest Pass, dating from 6340 ± 160 years B.P. (Driver 1976: 13). If the remains from Boss Hill are those of dog, its use as a beast of burden or for food remains speculative, while the presence of a fish vertebra might indicate that fishing was included in the overall food procurement strategy. In conclusion, ochre recovered from the site might suggest magico-religious practices.

4. SUMMARY

The evidence recovered through the excavation of the first occupation of the Boss Hill Site, Locality 2, suggests that a small hunting and gathering group of people, perhaps an extended family, made use of the natural shelter afforded by a small, dried up pond basin at the base of Boss Hill. The environment in which they lived, approximately 8,000 years before present, supported a number of diverse species of mammals, waterfowl, and invertebrates indicative of, perhaps, a local parkland environment. The hunters, as predators, utilized a large cross-section of the existing animal community as food, and it is speculated that a wide range of plants were utilized as well. The camp was small and transitory, probably representing a few days in the late summer or early fall of the year. Tools were mostly manufactured from locally derived raw

materials, but, for the most part, were not fabricated on the site itself. In addition, they reflect a generalized kit adapted to environmental variety, not only suggestive of hunting, but of processing both animal and vegetable foods.

CHAPTER VI

CONCLUSIONS

REVIEW AND SUMMARY OF OBJECTIVES

As stated in the first chapter of this monograph, the general objective of this study is to demonstrate that a phenomenon defined as the Pre-Archiac for the southern periphery of the Plains, was also manifest on the northwestern periphery of the Plains, in the Parkland of central Alberta. This general objective is to be achieved through the elucidation of eight specific objectives introduced in Chapter I. They are summarized as follows:

1. THE FIRST OBJECTIVE

This objective is to substantiate lanceolate and notched projectile points as coeval at the Boss Hill Site through stratigraphic association.

The occurrence of two projectile point styles within the first occupation can be variously interpreted. It could represent the occupation of the site by two separate cultural groups at different times, or perhaps, simultaneous occupation by two cultural groups. The interpretation the author favors is a third alternative. It represents a single occupation by a single cultural group.

The projectile points, representing two basic technological traditions were recovered _in situ_ and in direct stratigraphic association with one another. In addition, the cultural features that these artifacts were associated with appeared to be undisturbed

(Figure 4). The pedological record is suggestive of fluctuating water levels and rapid deposition during the period of the Altithermal in which the Boss Hill Site was occupied. The local habitat during a particular season of a given year may have been attractive to, for example, prey species utilized by man. During the same season the following year a dramatic drop in effective precipitation and a resulting lowering of water levels could cause the area to be avoided by those same prey species, and, consequently, by man. This type of dramatic fluctuation, as recorded in the soil profile of the first occupation, has been contemporarily documented by direct observation, as discussed in Chapter II.

Furthermore, in support of a single occupation, the topographic nature of the site, located as it was in a small, natural catch-basin, prevented the dispersion of the archaeological material it contained. Faunal and floral remains also documented a particular season of occupation. It appears, therefore, that there are data to support the technological traditions as coeval. These data are also supported by similar associations in other sites such as Renier (Mason and Irwin 1960), Fletcher (Forbis 1968), and Fullerton (Taylor 1968, 1969). Moreover, these sites also provide data to support the author's contention that the two technological traditions were possessed at the same time by a single cultural group.

2. THE SECOND OBJECTIVE

This objective is to establish a preliminary chronological framework for the Pre-Archaic in Alberta based on data from the Boss Hill Site. From the data it is suggested that the Pre-Archaic

became manifest about 8,000 years B.P. This is supported by the radiocarbon dates from the Boss Hill Site (Table 17 and Chapters III and IV). The acceptance of these dates was encouraged by an understanding of the nature of deposition at Locality 2, and further supported by the positive laboratory identification of the Mount Mazama Volcanic Ash, a horizon marker at the site. This horizon marker was separated from and positioned above the human occupation in question (see Appendix II and Figure 5).

3. THE THIRD OBJECTIVE

The third objective of this study is to suggest a possible local environmental reconstruction based on ecological data derived from the Buffalo Lake area and the Boss Hill Site.

The avenue of deriving palaeoecological data through collection and analysis of fossil pollen was explored. The results (Appendix VI) were inconclusive. The analysis of faunal remains was, indeed, more rewarding in this respect. The number, and particularly, the diversity of species in terms of habitat requirements presented a strong case for a local parkland environment.

4. THE FOURTH OBJECTIVE

This objective is to suggest the lifestyle of the Pre-Archaic people at Boss Hill.

This objective was attained as fully as the constraints of the excavated archaeological record, and time, would allow. The cultural remains from the Boss Hill Site represent a series of hunting, gathering, and food processing activities which took place

over a relatively short period of time. Perhaps, realistically they represent at best only a faint glimpse at an implied series of cultural activities which, in turn, represent only part of a seasonal round. Ideally, in order to be more fully insightful, it would be necessary to study a number of sites in different ecological zones left by a single culture, and representing artifacts of a total seasonal round.

The Fletcher Site may be quite valuable in this respect. It probably represents a different cultural group than that of Boss Hill; however, as at Boss Hill, two technological traditions are represented. Forbis (1968) may indeed be correct in assuming that the people at the Fletcher Site were big game hunters. However, and this is an important qualification, the Fletcher Site represents only one of a series of activities which would normally be attributed to a seasonal round. In other ecological areas and at different times of the year, different types of activities no doubt took place. An area seasonally rich in plant resources, small mammals, fish, water, fuel, and shelter would, no doubt, require of people, as exploiters, a shift in substance strategy. This shift should be reflected in the archaeological record in terms of both tools and food remains.

5. THE FIFTH OBJECTIVE

This objective is the determination of reasons for the specific preservation of the Boss Hill Site and the implications for finding similar sites elsewhere.

The first requirement and primary cause of site preservation

at Boss Hill was rapid deposition. Two principal factors were involved. The position of the campsite within a natural catch basin and at the base of a hill. Secondly, the geological nature of the hill itself. The first factor has been dealt with at length in Chapters IV and V. The second factor, though dealt with previously as well, needs more explanation.

Being a moraine plateau, Boss Hill was very plastic after deglaciation; a condition which, however, became less pronounced with the passing of time. Given the more recent archaeological evidence on top of Boss Hill, it may be reasonable to assume that it was occupied or at least utilized by the people who camped at its base some 8,000 years B.P. The top of Boss Hill, however, only stabilized to a certain extent after 5,000 years B.P. (Doll 1980). Likewise there were perhaps several other potentially good campsites in the immediate area which were used 8,000 years ago. Certainly the food resources in the area would have been equally available to people who may have camped within a half kilometre of each other. Evidence for these other sites, however, had not been preserved, or at least not found to be preserved.

As to the location of similar archaeological sites elsewhere in Alberta, this study can offer the following suggestions. In general, a primary requirement would be an environment supporting and encouraging species diversity, namely, a grassland-forest ecotone. Within this ecotone, a good, perhaps permanent, supply of water and fuel would be a prerequisite. Protection from the prevailing winds, which appear to be dominated by north westerlies

and a location at the base of a prominent land feature are essential. Geological landforms, especially moraine plateaux, would probably contribute to a more stable post-depositional environment compare, for example, to the sand dunes in which the Fullerton Site is situated (Taylor 1969). Moraine Plateaux are readily identifiable on topographic maps and aerial photographs. Additionally, and not least important, palaeocological research aimed at determining on a wider scale the former extent of the Aspen Parkland, would circumscribe the relevant research area.

6. THE SIXTH OBJECTIVE

This objective is to suggest possible derivation of the two projectile point technological traditions represented in the sample from the first occupation at Boss Hill.

This objective was attained through detailed comparison and discussion in Chapter V. In summary, the lanceolate technological tradition appears to be immediately derived from the Agate Basin tradition that developed on the Northern Plains. The derivation of the notched tradition is somewhat harder to document. The bulk of the evidence, however, suggests origin in the Eastern Woodlands.

7. THE SEVENTH OBJECTIVE

This objective is to establish a terminal date for the manifestation of the Pre-Archaic, a transition period in Alberta.

The Fletcher Site (Figures 1 and 2) dated at 7655 $\pm$ 110 years B.P. (Quigg 1976: 108) appears to be the most recent, reliably dated Pre-Archaic manifestation in Alberta at this juncture.

That this be tentatively set as a terminal date for the Pre-Archaic in Alberta is perhaps reasonable in light of dates obtained from Early Plains Archaic sites farther south. Pretty Creek (Figure 1), perhaps the earliest Early Plains Archaic site on the northwestern Plains, is dated at 7685 years B.P. (Frison 1978) and Mummy Cave is dated at 7630 years B.P. (Husted 1978). In Alberta, the Early Plains Archaic became manifest at the Stampede Site in the Cypress Hills (Figure 1 and 2) at 7245 years B.P. (Gryba 1975) at which time lanceolate projectile points of the Palaeo-Indian tradition disappear.

The transition from late Palaeo-Indian to Early Plains Archaic appears to have taken place over the period of a millenia, between approximately 8,000 and 7,000 years B.P.

8. THE EIGHTH OBJECTIVE

The last objective of this study is to develop a hypothesis for cultural transition in the Parkland of Alberta. This objective is discussed and a hypothesis developed in the following section.

A HYPOTHESIS FOR CULTURAL TRANSITION IN THE ASPEN PARKLAND OF CENTRAL ALBERTA

Hickey's (1974) discussion of the effects of treeline shifts on human societies is particularly applicable to the understanding of the implications of the Boss Hill Site. Hickey (1974: 89) suggests that ". . . forest edge areas ought not to be thought of as being as inhospitable as barbed wire, but that they may in fact "draw" people from the classic -- and perhaps over-emphasized archaeologically -- natural communities which flank them." Once drawn into the edge areas, conditions for cultural contact exist. Hickey (1974: 89) goes on to state: "no matter the nature of contact, then, awareness of other cultural groups is virtually assured which may result in some kind of mutual enrichment."

Losey's (1977) study of prehistoric cultural ecology in the prairie-forest transition zone of Alberta provides both ethnohistorical and archaeological documentation supporting the application to the Aspen Parkland of Hickey's theoretical approach.

Syms (1977, 1980) studied prehistoric cultural ecology in southwestern Manitoba where the Northeastern Plains grades into the Aspen Parkland. He developed what he termed the "Co-Influence Sphere Model" as an explanation for cultural change. the co-influence sphere includes

> . . . those cultural areas of an ethnic group that are affected, or perceived to be affected, by contact with one or more other groups. It includes settlement pattern, subsistence strategy and technology, art style, language, religious myths, and other oral

> traditions, and biological "blending" (where interbreeding takes place). The magnitude of co-influence can vary from negative exclusion, whereby the presence of one group primarily changes the settlement pattern of other groups . . . to assimilation and acculturation . . . The nature and degree of co-influence depends upon the nature, intensity, and duration of interaction (Syms 1980: 112-114).

Syms (1980) suggests that in the archaeological record, which is the primary concern of the Boss Hill study, co-influence patterns are most evident in the settlement patterns and in the technology.

With respect to settlement patterns, Frison (1978: 370) gives vegetative diversity as a main determinant in the location of Archaic sites. He suggests that areas of plant diversity affected animals in different ways. Some species would utilize an area only at certain times while others made use of those areas as their natural habitats. Therefore, the hunting pattern as well as the plant gathering patterns were affected by such areas.

Sites in the prairie-forest transition zone as outlined by Losey (1977), and the Boss Hill Site specifically, reflect this differential utilization. Bison (*Bison sp.*) and elk (*Cervus canadensis*) came off the prairie-grasslands to winter in the Aspen Parkland. Black bear (*Ursus americanus*) may have entered the transition zone from the forest to harvest wild berries in season. Some waterfowl populations made use of the area as their natural habitat from spring to fall while others used it as a staging area only. Taxa such as beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and rabbit (*Lepus sp.*), and fish were year-round residents. In addition, food plants were available on a seasonal

basis (see Appendix I). Thus, subsistence strategies and settlement patterns would be affected by seasonal availability of food resources within the transition zone.

During the Late Prehistoric and Early Historic periods, Losey (1971) and Syms (1977, 1980) document both "traditionally" forest groups and Plains groups of hunters and gatherers who made use of the Aspen Parkland on an intermittant, seasonal basis. Likewise, the earliest group represented at Buffalo Lake maintained a hunting and gathering economy, and was subject to similar environmental and perhaps cultural pressures and influences. The late-summer, early-fall settlement patterns as outlined by Losey (1977) and Syms (1977) are comparable to the observed pattern in the archaeological record at Buffalo Lake, except for chronological and technological considerations.

Hickey (1974: 92) suggests ". . . that the forest-edge may have served as both a selective cultural filter and as an agent of innovation and recombination of cultural traits." With respect to technology, the technological tradition reflected by the projectile point forms used at Boss Hill, appears to be a combination of two older separate traditions. Unfortunately, since no other dated sites with similar combinations have come to light in the Parkland or adjacent areas, there are insufficient data to state, with any precision, the direct origin of the people who left this record. They may have been descendants of Palaeo-Indian hunters who had occupied the Plains for four millenia. Alternatively, they could have been descendants of migrants from the Eastern Woodlands. Whatever the

case, the prairie-forest ecotone may have provided an area of "co-influence" (Syms 1977, 1980) where people bearing the two technological traditions came into contact.

What about the descendants of the Boss Hill hunting and gathering band? A cultural hiatus at Boss Hill, lasting approximately 1,000 years, is evinced by the culturally sterile strata between the earliest dated occupation and the occupation underlying the fall of Mazama Ash (see Figure 5). Although the apparent hiatus may reflect inadequate sampling, it is suggestive of that period of the Altithermal in which the area was most severely dessicated. There is also a marked decrease in the rate of sediment deposition in these strata at Boss Hill (Figure 5). If occupations dating from within this time period (ca. 6800 to 7800 B.P.) exist in the Buffalo Lake area, they might be found below present day lake levels.

Possibly three excavated sites in Alberta have been dated within this proposed period of cultural hiatus. The Gap Site (Figures 1 and 2) yielded Bitterroot side-notched points dated at 6720 years B.P. in a stratum below Mazama Ash (Reeves and Dormaar 1972). The Stampede Site (Figures 1 and 2), which yielded the same type of projectile points located below volcanic ash, was dated at 7245 years B.P. (Gryba 1975). The East Battle Creek Site (Figures 1 and 2) yielded notched points that may have dated at 7300 years B.P. (Bryan, University of Alberta, personal communication). The Gap Site is located along the eastern slope of the Rocky Mountains, while the Stampede and East Battle Creek Sites are in the Cypress Hills. All represent Early Plains Archaic occupations lacking lanceolate

points.

The record of occupation in these areas of higher topographical relief during the proposed 1,000 year hiatus at Buffalo Lake suggests a shift in the seasonal round. When the shallow lakes and sloughs dried up during the Altithermal peak, as is suggested by the extreme drop in water levels in much deeper northern lakes such as Cold Lake (Schweger, University of Alberta, personal communication), bands of hunters and gatherers appear to have moved into these more favorable areas. This may have been in response to the movement of bison and other species seeking areas of higher elevation less susceptible to drought.

With this settlement pattern shift appears a technological shift. Lanceolate projectile points of Palaeo-Indian affinity give way to notched points. This perhaps reflects a change in subsistence strategy. Perhaps species including Odocoileus and Ovis in those areas of higher elevation might be harvested more easily using the atlatl and darts tipped with small notched projectile points, rather than lanceolate points and the hand-held spear.

It appears however, that these areas of higher elevation, the Cypress Hills, and the foothills of the Rocky Mountains, were ecological substitutes for the former Aspen Parkland particularly during the 1000 year period in question.

Simultaneous with what appears to be a preference for higher elevations is the possibility of a population movement northward into the forested areas. This proposed movement may have given rise to the Northern Archaic (Workman 1978: 428; personal communi-

cation) and perhaps the Shield Archaic cultures. Here both notched and lanceolate point technological traditions persisted. This hypothesis parallels a proposal put forward by Wright (1972, 1976), who suggested that the Shield Archaic culture may have derived from northern Agate Basin affiliated Palaeo-Indians.

By perhaps 6,700 to 6,000 years B.P., Early Plains Archaic people had reoccupied the Parkland on an intermittant basis. This is supported by evidence at the Boss Hill and Gowen Sites (Figures 1 and 2). By 4,790 years B.P. (Table 17) the Oxbow Culture, the last manifestation of the Early Plains Archaic, was established in the Parkland. Subsequently, Middle and Late Plains Archaic and Late Prehistoric Period people continued a more or less uninterrupted, intermittant seasonal occupation of the Aspen Parkland until historic times (Losey 1977; Syms 1977, 1980).

In conclusion, Losey (1977) and Syms (1977, 1980) have demonstrated the importance of the Aspen Parkland as a resource area utilized seasonably by animals and man. Hickey (1974: 90) emphasizes the importance of forest edge areas as zones of cultural contact with "very high potential for evolutionary change." These concepts form a framework in which to examine the Pre-Archaic.

In Texas, where the concept of the Pre-Archaic was proposed by Sollberger and Hester (1972) the relevant sites were located within a forest-edge ecotone on the southeast periphery of the Plains. The vegetation was determined by pollen analysis to be characteristic of a parkland (Sollberger and Hester 1972: 340). Manifestations of pre-existing Palaeo-Indian cultures were already

recorded on the Plains as was a side-notched point technological tradition in the Eastern Woodlands. The strategic location and the resources in this ecotone, joining the two areas, appears to have been paramount in bringing about these Pre-Archaic manifestations.

In the central Alberta Parkland, there was an analogous, perhaps even a parallel, manifestation chronologically, ecologically, and technologically. It is represented in the first occupation at Locality 2 of the Boss Hill Site.

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TABLE 1

METRIC ATTRIBUTES OF PROJECTILE POINTS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	BODY WIDTH (mm)	MAXIMUM THICKNESS (mm)	STEM LENGTH (mm)	WIDTH BETWEEN NOTCHES (mm)	SHOULDER WIDTH a+b (mm)	WEIGHT (g)
1.	H78.22.125	48.32	24.78	7.24	N/A	N/A	N/A	6.45
2.	H78.22.167	43.22	25.06	6.56	N/A	N/A	N/A	8.10
3.	H78.22.165	54.30	24.42	6.24	8.20	11.98	4.82 5.14	5.70
4.	H78.22.173	42.44	22.52	6.44	6.02	12.40	3.06 IND.	5.40
5.	H78.22.124	26.98	18.50	5.18	11.28	9.48	4.70 4.26	2.45
6.	H78.22.135	26.22	18.16	5.50	10.84	10.58	3.58 3.66	2.05
7.	H78.22.107	10.92	17.50	5.14	IND.	14.86	IND. IND.	11.50
8.	H78.22.114	8.48	5.68	2.86	N/A	N/A	N/A N/A	7.05
9.	H78.22.123	14.10	11.34	4.54	N/A	N/A	N/A N/A	6.50
10.	H77.55.484	11.16	10.54	2.86	N/A	N/A	N/A N/A	.10

TABLE 2

METRIC ATTRIBUTES OF BIFACES AND BIFACE FRAGMENTS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
11.	H78.22.176	83.92	39.40	14.08	39.60
12.	H78.22.163	85.76	46.98	11.58	39.95
13.	H78.22.168	129.26	55.74	16.60	114.75
14.	H78.22.118	61.30	32.80	11.04	22.25
15.	H78.22.70	88.22	40.60	14.96	65.05
16.	H78.22.131	46.56	33.34	11.80	18.75
17.	H78.22.116	21.28	27.72	6.60	4.20
18.	H78.22.112	13.70	11.82	6.06	.50
19.	H76.42.135	41.30	28.54	9.82	13.25
20.	H76.42.183	21.02	16.76	5.46	1.45

TABLE 3

METRIC ATTRIBUTES OF END SCRAPERS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	DISTAL THICKNESS (mm)	MAXIMUM THICKNESS (mm)	DEGREES EDGE ANGLE RANGE	DEGREES EDGE ANGLE CENTRE	WEIGHT (g)
21.	H77.55.327	24.04	17.68	5.96	6.56	63-78	68	3.65
22.	H78.22.77	21.52	22.16	5.30	6.64	65-75	73	3.40
23.	H78.22.180	21.50	13.80	5.76	8.28	61-67	67	2.55
24.	H78.22.122	29.34	19.40	5.56	7.76	55-105	77	3.95
25.	H77.55.490	19.98	15.08	5.42	5.34	52-65	54	1.75
26.	H78.22.161	16.34	16.86	6.36	7.22	47-77	74	2.55
27.	H78.22.72	22.68	18.54	8.89	8.96	73-85	77	4.45

TABLE 4

METRIC ATTRIBUTES OF SPOKESHAVE/GRAVER

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
28.	H77.55.533	28.86	9.94	8.26	1.95

TABLE 5

METRIC ATTRIBUTES OF UNIFACIALLY RETOUCHED FLAKES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
29.	H77.55.333	51.78	50.32	11.80	34.90
30.	H77.55.426	60.98	46.61	7.26	20.70
31.	H77.55.496	59.08	27.16	8.64	15.70
32.	H78.22.166	24.86	21.38	4.52	3.00
33.	H77.55.215	58.02	35.64	13.14	13.00
34.	H77.55.332	23.90	22.94	2.26	1.20
35.	H78.22.132	38.94	22.92	3.58	4.30
36.	H78.22.73	31.60	20.12	3.30	1.80
37.	H78.22.179	49.80	40.70	5.90	11.80
38.	H78.22.164	37.40	26.54	7.82	6.70
39.	H77.55.483	30.16	12.66	6.46	1.70
40.	H78.22.162	56.04	25.68	5.64	5.00
41.	H77.55.328	31.36	17.40	3.98	1.45

TABLE 6

METRIC ATTRIBUTES OF PIECES ESQUILLEES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
42.	H78.22.129	37.82	28.56	9.86	12.00
43.	H78.22.111	31.42	13.28	9.22	5.05
44.	H77.55.527	39.30	13.68	12.32	6.65
45.	H78.22.172	38.74	23.26	11.38	12.10

TABLE 7

METRIC ATTRIBUTES OF UTILIZED FLAKES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
46.	H77.55.325	36.94	19.12	5.56	5.45
47.	H78.22.31	33.48	11.18	5.98	2.70
48.	H78.22.69a	28.40	16.34	7.22	2.90
49.	H78.22.69b	INCLUDED IN ABOVE			
50.	H77.55.541	20.50	20.02	5.74	2.25
51.	H78.22.126	24.92	14.50	4.82	1.80
52.	H78.22.121	18.32	14.30	2.10	.70
53.	H77.55.328a	19.40	11.92	3.84	.95
54.	H78.22.178	41.74	23.86	5.76	7.30
55.	H77.55.495	21.34	20.06	7.42	2.75
56.	H78.22.113	23.98	23.54	6.20	2.45
57.	H78.22.128	54.46	30.42	11.16	20.60
58.	H78.22.136	93.99	90.52	20.32	135.40
59.	H78.22.175	100.80	77.62	20.54	150.90

TABLE 8

METRIC ATTRIBUTES OF LARGE CHIPPED STONE TOOLS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
60.	H77.55.375	127.22	85.34	24.58	412.80
61.	H78.22.171	121.58	70.96	30.34	357.70
62.	H78.22.183	150.60	77.52	35.92	437.85
63.	H78.22.170	119.56	61.64	22.14	206.55
64.	H78.22.74	80.22	71.02	29.48	120.00
65.	H78.22.108	106.04	73.44	30.74	295.75
66.	H77.55.377	163.46	113.44	36.50	568.30

TABLE 9

METRIC ATTRIBUTES OF HAMMERSTONES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
67.	H78.22.189	76.12	72.70	48.46	356.45
68.	H78.22.110	54.82	50.76	44.76	127.20
69.	H77.55.492	55.88	34.86	25.56	69.50
70.	H77.55.363	80.94	54.48	26.64	86.70
71.	H77.55.212	112.00	109.00	73.00	1264.00

TABLE 10

METRIC ATTRIBUTES OF ANVILS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
72.	H78.22.115	139.42	108.44	52.96	984.60
73.	H78.22.190	155.60	120.32	80.00	1666.70
74.	H78.22.181	190.74	101.82	76.30	1986.70
75.	H77.55.494	151.52	124.92	54.46	1212.05

TABLE 11

METRIC ATTRIBUTES OF MILLING STONES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
76.	H77.55.501	96.40	95.86	34.72	431.85
77.	H78.22.119	122.56	80.18	43.02	600.80

TABLE 12

METRIC ATTRIBUTES OF BIPOLAR SPLIT PEBBLES

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
78.	H77.55.418	42.96	16.02	4.88	3.85
79.	H76.42.177	35.10	18.54	8.80	7.70
80.	H76.42.187	33.30	18.64	6.28	3.60
81.	H78.22.127	29.56	18.54	6.36	4.20
82.	H77.55.491	21.76	14.04	10.30	3.50

TABLE 13

METRIC ATTRIBUTES OF LARGE CORES AND CORE FRAGMENTS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
74.	H78.22.181	190.74	101.82	76.30	1986.70
75.	H77.55.494	151.52	124.92	54.46	1212.05
83.	H78.22.117	51.72	35.74	10.66	31.25
84.	H77.55.499	42.54	27.78	22.26	33.05
85.	H77.55.540	42.68	41.70	30.50	50.70
86.	H77.55.528	32.06	17.26	9.74	3.45
87.	H77.55.539	32.34	16.12	11.38	4.50

TABLE 14

METRIC ATTRIBUTES OF OCHRE

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
88.	H78.22.75	48.92	30.90	18.09	32.70

TABLE 15

METRIC ATTRIBUTES OF BONE TOOLS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
89.	H76.42.136	36.24	18.80	6.36	2.65

TABLE 16

METRIC ATTRIBUTES OF ANTLER TOOLS

SPECIMEN NUMBER	CATALOGUE NUMBER	MAXIMUM LENGTH (mm)	MAXIMUM WIDTH (mm)	MAXIMUM THICKNESS (mm)	WEIGHT (g)
90.	H77.55.213	77.36	26.38	25.98	26.10

TABLE 17

RADIOCARBON DATES FROM THE BOSS HILL SITE LOCALITY 1 and 2

LAB NO.	DATE	MATERIAL	LOCALITY	CULTURAL AFFILIATION
S-1483	8090 ± 310 yrs. B.P.	Charcoal	2	Predates Occupation
S-1251	7875 ± 130 yrs. B.P.	Bone	2	Pre-Archaic
S-1371	7750 ± 105 yrs. B.P.	Charcoal	2	Pre-Archaic
S-1250	6150 ± 95 yrs. B.P.	Charcoal	2	Possibly Contaminated Sample
S-1884	4790 ± 475 yrs. B.P.	Bone	1	Early Plains Archaic
S-1164	2335 ± 70 yrs. B.P.	Bone	1	Middle to Late Plains Archaic
S-1883	1860 ± 55 yrs. B.P.	Bone	1	Late Plains Archaic Initial Lake Prehistoric
S-1165	200 ± 60 yrs. B.P.	Bone	2	Late Prehistoric

FIGURE 1

Map of Western North America
Showing Location of Archaeological
Sites Mentioned in the Text.

1. Canyon
2. Grant Lake
2. Migod
4. Peace Point
5. Lake One Dune
6. Drayton Valley
7. Gwynne Tower
8. Fullerton
9. Edberg Tower
10. Boss Hill
11. Sibbald Flats
12. Gap
13. Pass Creek
14. Stampede
15. East Battle Creek
16. Fletcher
17. Black Lake
18. Gowen
19. Parkhill
20. Duck River
21. Itasca
22. Pretty Creek
23. Birch Creek
24. Wilson Butte Cave
25. Mummy Cave
26. Horner
27. Finley
28. Agate Basin
29. Brewster
30. Hawken
31. Betty Greene
32. Hell Gap
33. Scottsbluff
34. Logan Creek
35. Simonsen
36. Renier
37. Hogup Cave
38. Danger Cave
39. Hungry Whistler
40. Olsen - Chubbuck
41. Graham Cave
42. Modoc Cave
43. St. Alban's
44. Smith Creek Cave
45. Blackwater Draw
46. Field Ranch
47. Hill Country
48. Stillhouse Hollow
49. Youngsport
50. Merrell
51. Jetta Court
52. Levi Rockshelter
53. Granite Beach
54. Baker Cave
55. Peril's Mouth
56. Strohacker
57. La Jita
58. Berclair
59. Stanfield-Worely Bluff

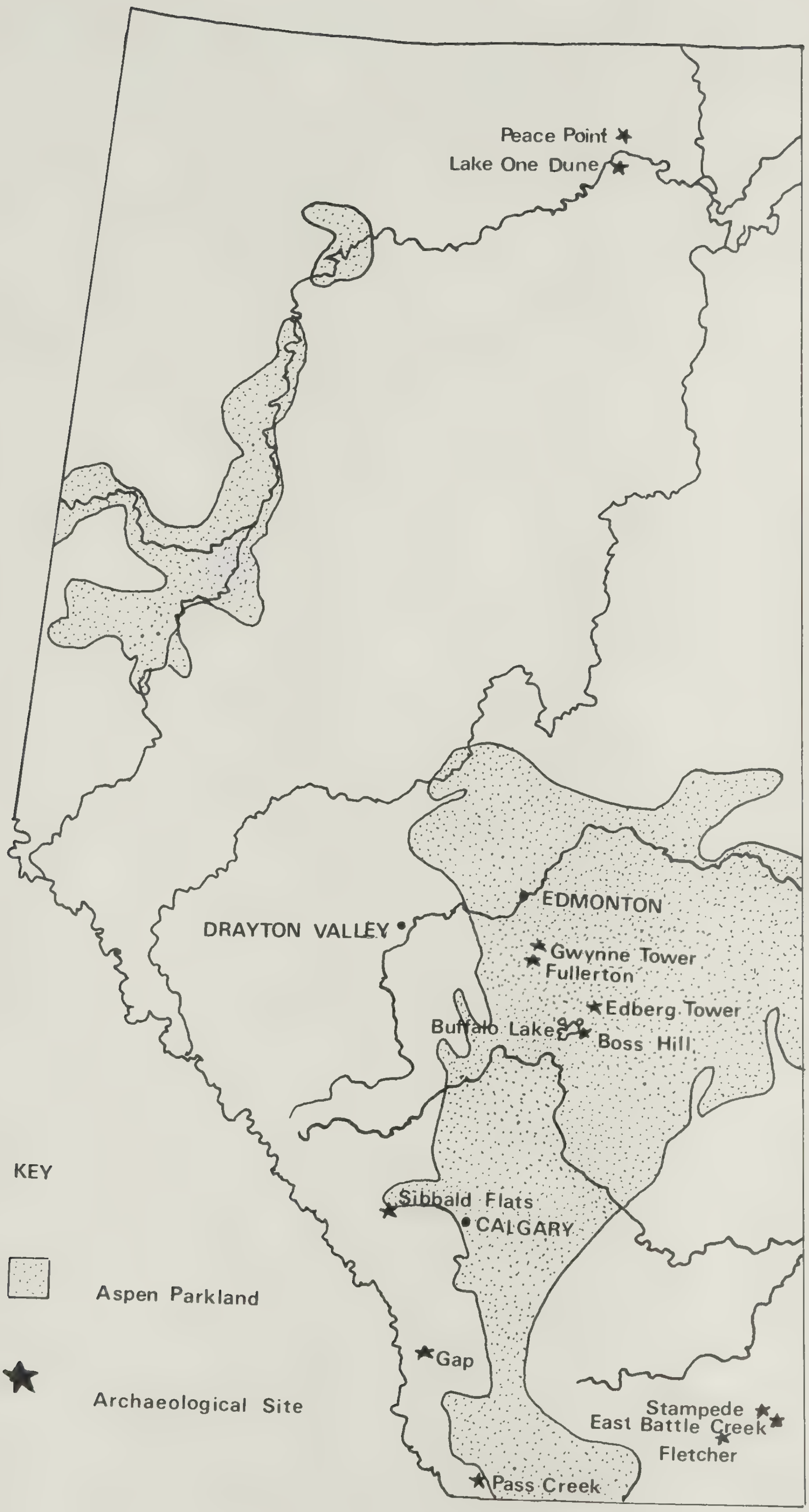


FIGURE 2

Map of Alberta Showing the Location and Relationship Between Archaeological Sites Discussed and the Aspen Parkland Ecological Zone.

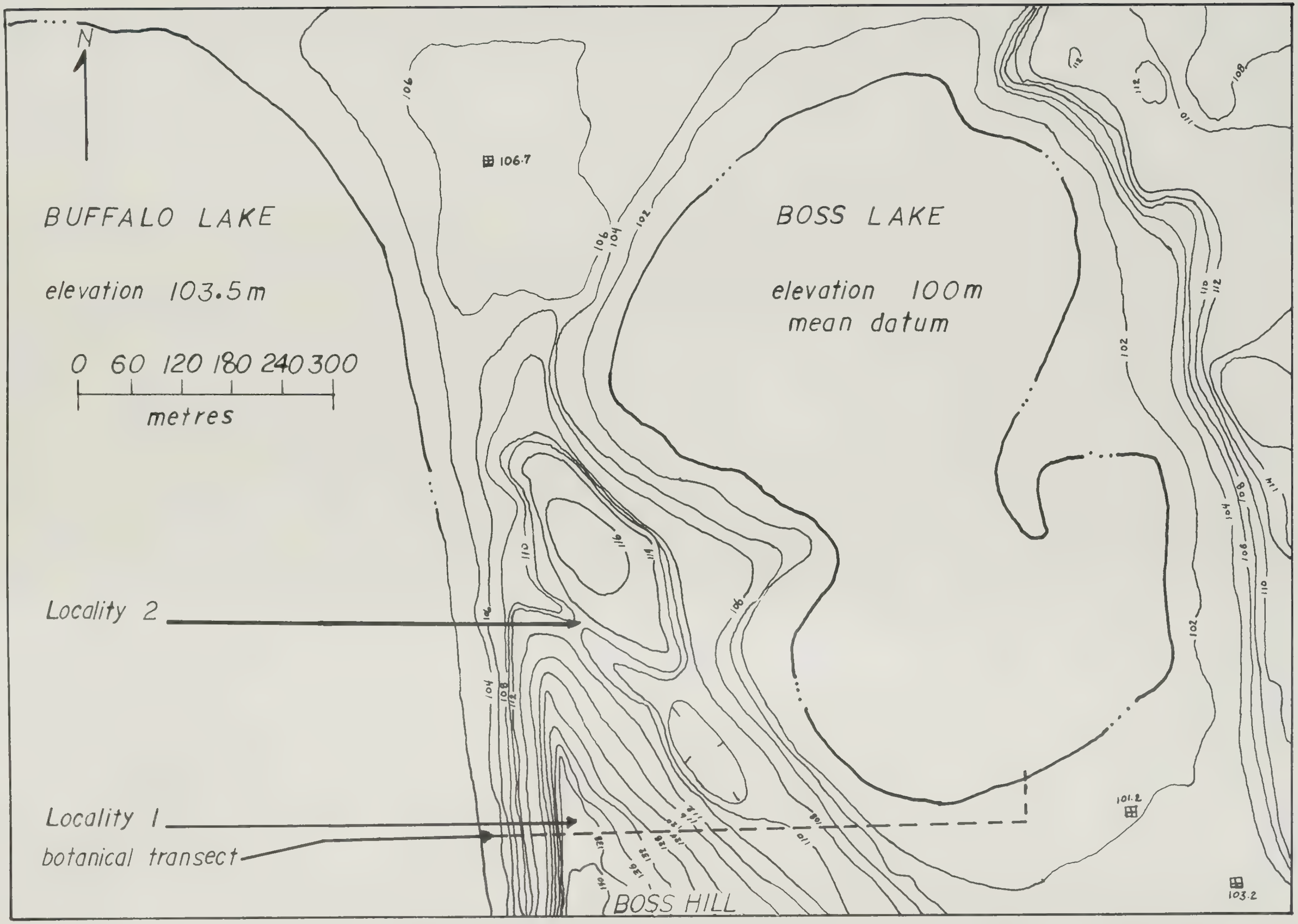


FIGURE 3 - Topographic Map of the Boss Hill Site
Locality 1 and 2 and the botanical transect

FIGURE 4 PLANVIEW OF ARTIFACTS AND FEATURES FROM THE FIRST OCCUPATION
THE BOSS HILL SITE, LOCALITY TWO

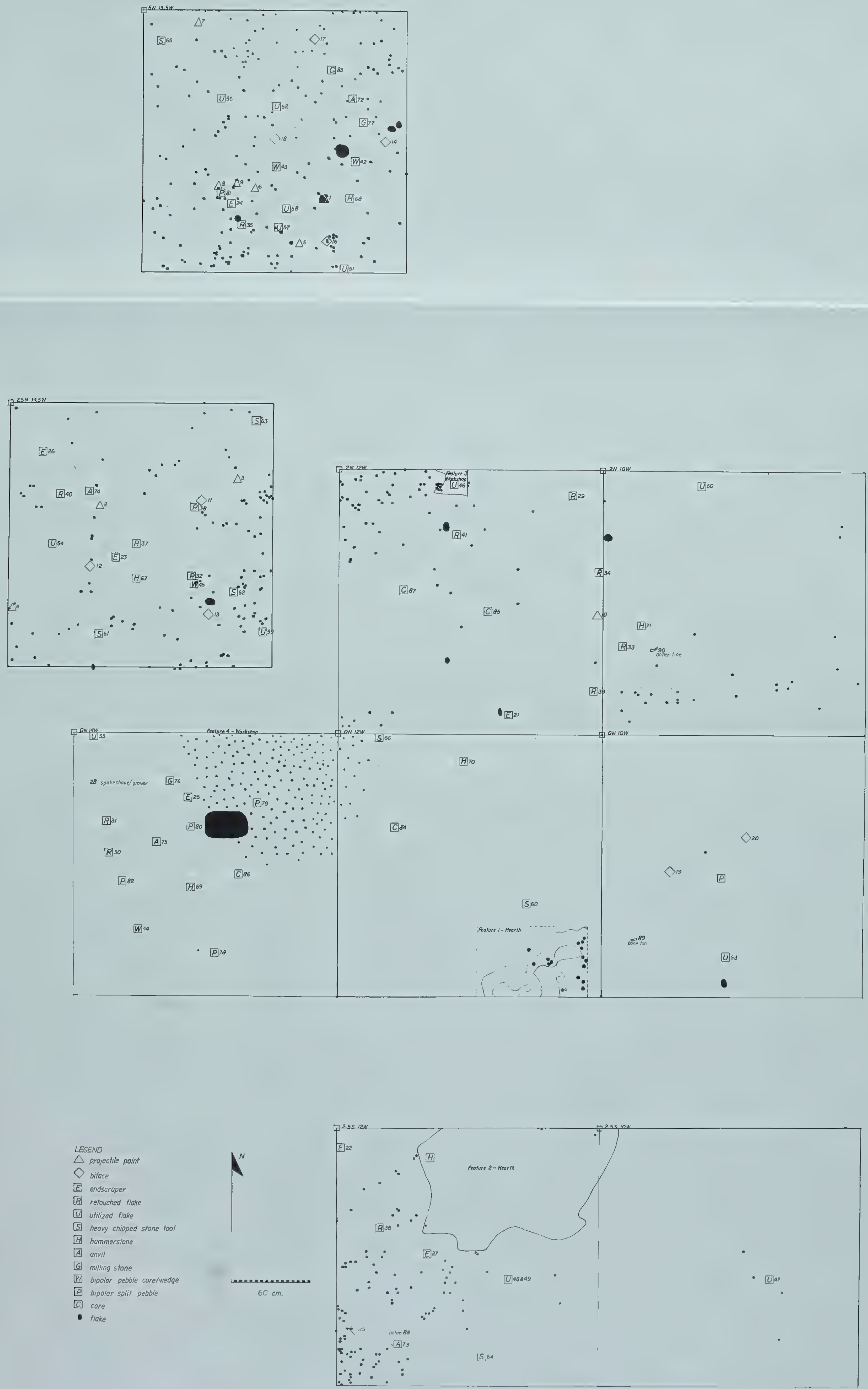
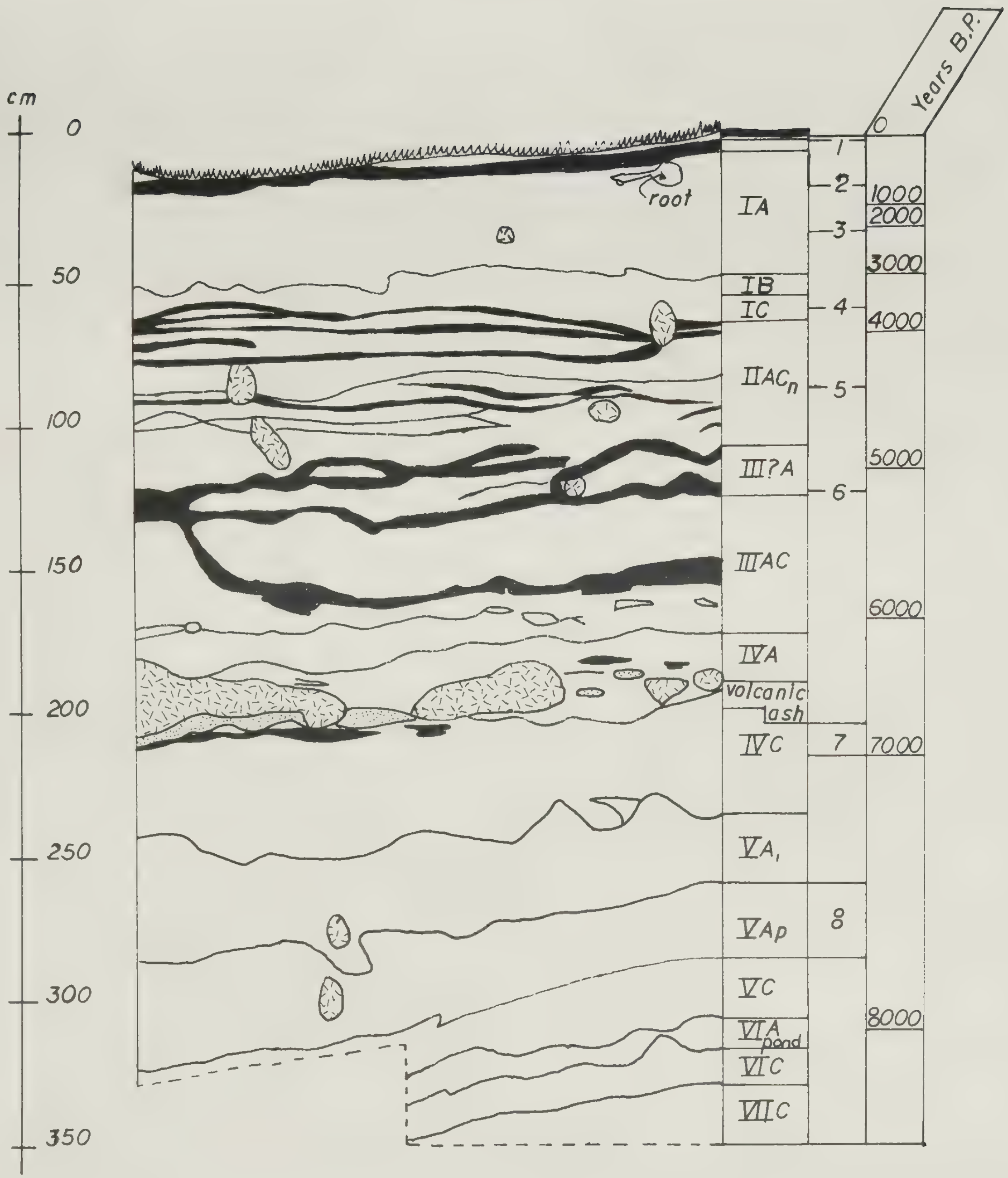


FIGURE 5



BOSS HILL LOCALITY 2
FdPe4
Profile–South Wall
Unit 2.5S 14.5W

KEY

Contemporary or buried A horizons

Mount Mazama Ash 6600 B.P.

Rodent burrows

1 Occupation – Contemporary
2 Occupation – Late Prehistoric – 200 ± 60 B.P.
3 Occupation – Late Plains Archaic – Ca. 2000 B.P.
4 Occupation – Middle Plains Archaic – Ca. 3600 B.P.
5 Occupation – Early Plains Archaic – 4462 B.P.?
6 Occupation – Early Plains Archaic – 5120 B.P.?
7 Occupation – Early Plains Archaic – Ca. 6600–7000 B.P.
8 Occupation – Pre-Archaic – 7875 ± 130; 7750 ± 105 B.P.

PLATE 1

PROJECTILE POINTS AND POINT FRAGMENTS

a. Specimen 1, Parkhill Lanceolate

b. Specimen 2, Parkhill Lanceolate

c. Specimen 3, Boss Hill Corner-Notched

d. Specimen 4, Boss Hill Corner-Notched

e. Specimen 5, Boss Hill Corner-Notched

f. Specimen 6, Boss Hill Corner-Notched

g. Specimen 7, Boss Hill Corner-Notched

h. Specimen 8, Unclassified Projectile Point Fragment

i. Specimen 9, Unclassified Projectile Point Fragment

j. Specimen 10, Unclassified Projectile Point Fragment

PLATE 1

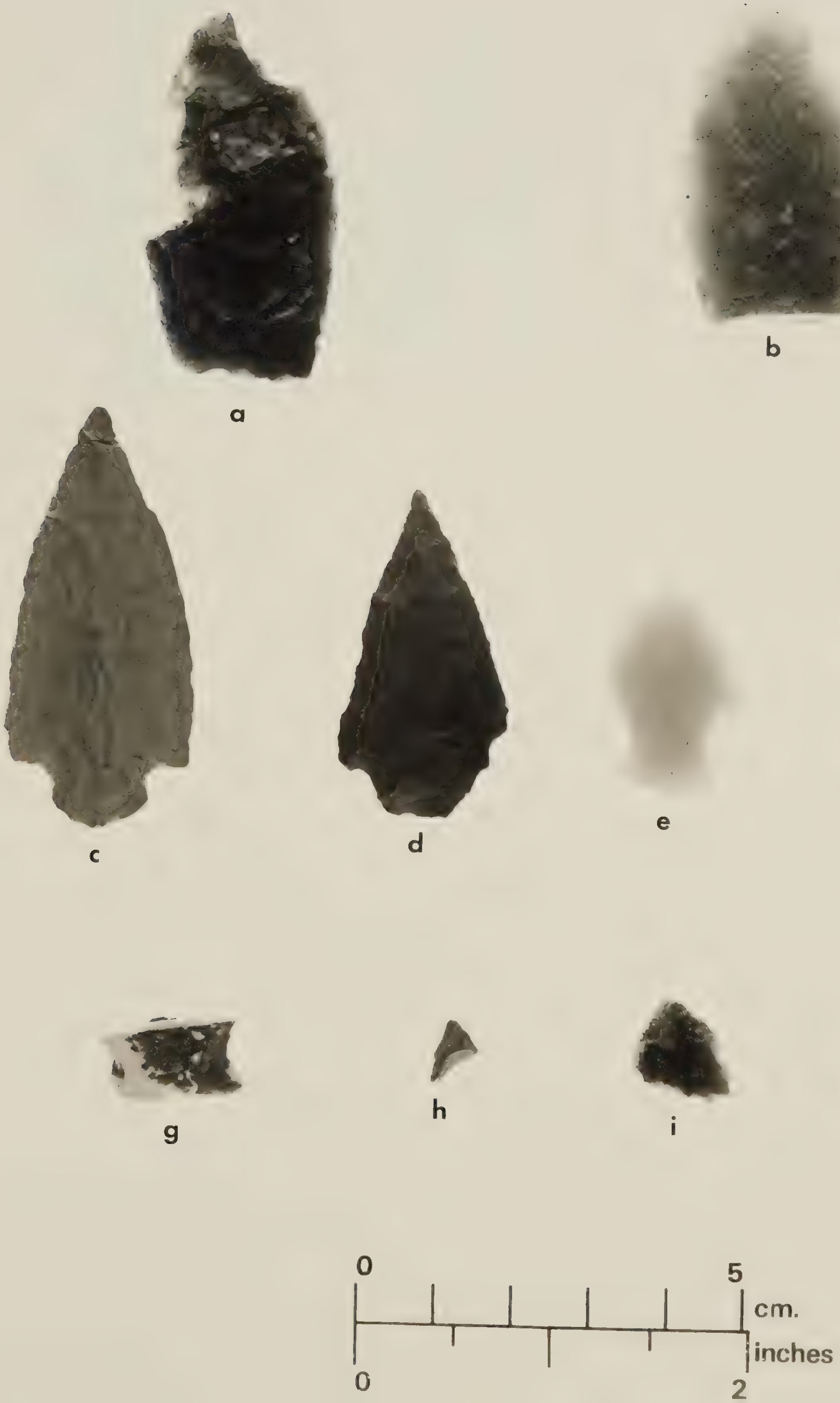


PLATE 2

BIFACES AND BIFACE FRAGMENTS

a. Specimen 11, biface-hafted knife

b. Specimen 12, biface-hafted knife

c. Specimen 13, bipointed biface

d. Specimen 14, rectangular biface

e. Specimen 15, rectangular biface

f. Specimen 16, biface tip fragment

g. Specimen 17, biface tip fragment

h. Specimen 18, biface body fragment

i. Specimen 19/20, biface fragment reconstructed from two pieces

PLATE 2

PLATE 3

ENDSCRAPERS AND SPOKESHAVE/GRAVER

a. Specimen 21, Category 1 Endscraper

b. Specimen 22, Category 1 Endscraper

c. Specimen 23, Category 2 Endscraper

d. Specimen 24, Category 2 Endscraper

e. Specimen 25, Category 2 Endscraper

f. Specimen 26, Category 3 Endscraper

g. Specimen 27, Category 3 Endscraper

h. Specimen 28, Spokeshave/Graver

PLATE 3

PLATE 4

UNIFACIALLY RETOUCHED FLAKES

a. Specimen 29, Unifacially Retouched Flake

b. Specimen 30, Unifacially Retouched Flake

c. Specimen 31, Unifacially Retouched Flake

d. Specimen 32, Unifacially Retouched Flake

e. Specimen 33, Unifacially Retouched Flake

f. Specimen 34, Unifacially Retouched Flake

g. Specimen 35, Unifacially Retouched Flake

h. Specimen 36, Unifacially Retouched Flake

i. Specimen 37, Unifacially Retouched Flake

j. Specimen 38, Unifacially Retouched Flake

k. Specimen 39, Unifacially Retouched Flake

l. Specimen 40, Unifacially Retouched Flake

m. Specimen 41, Unifacially Retouched Flake

PLATE 4

PLATE 5

UTILIZED FLAKES

a. Specimen 46, Utilized Flake

b. Specimen 47, Utilized Flake

c. Specimen 48, Utilized Flake

d. Specimen 49, Utilized Flake

e. Specimen 50, Utilized Flake

f. Specimen 51, Utilized Flake

g. Specimen 52, Utilized Flake

h. Specimen 53, Utilized Flake

i. Specimen 54, Utilized Flake

j. Specimen 55, Utilized Flake

k. Specimen 56, Utilized Flake

l. Specimen 57/58, Utilized Flake Reconstructed From Two Pieces

m. Specimen 59, Utilized Flake

PLATE 5

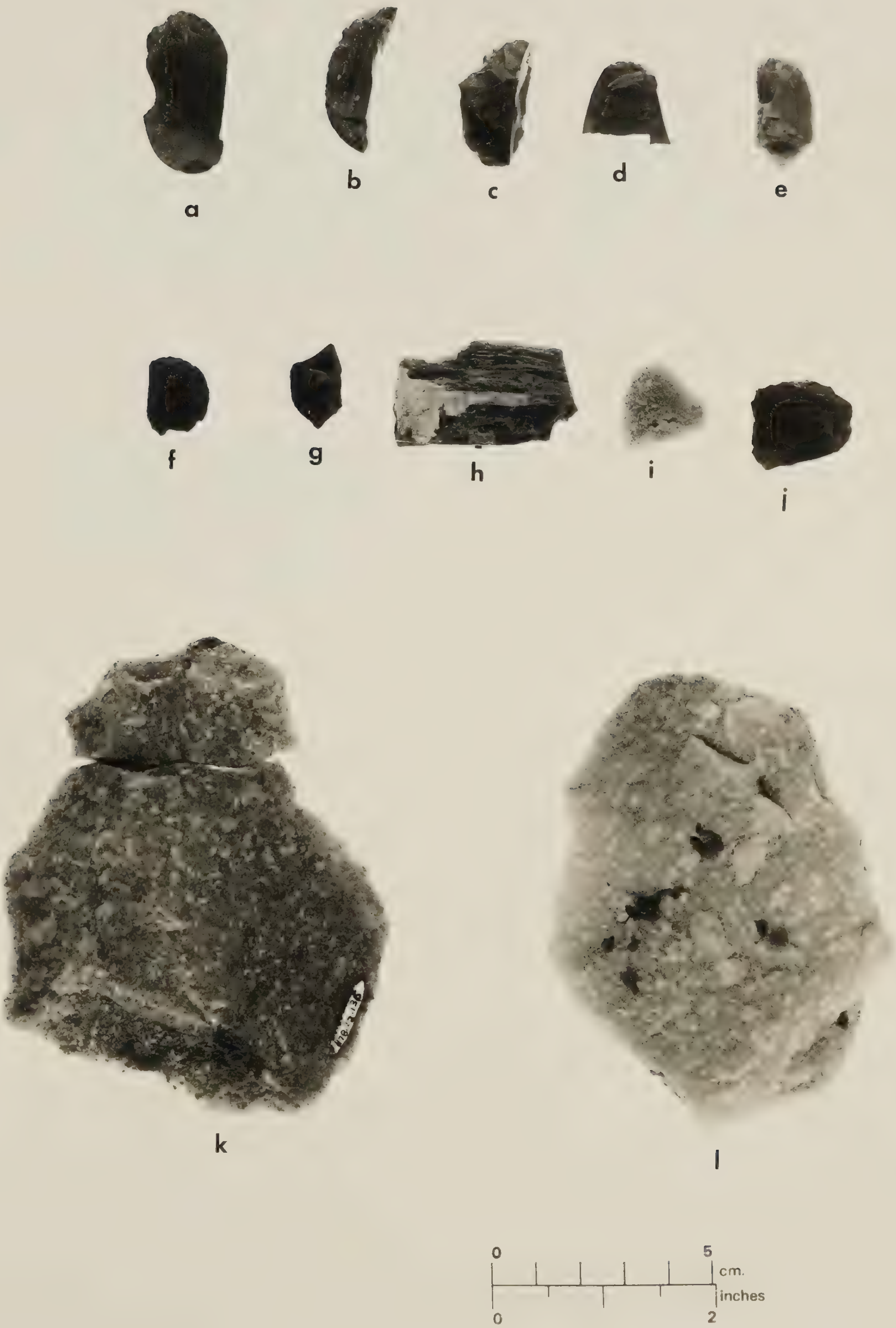


PLATE 6

LARGE CHIPPED STONE TOOLS

a. Specimen 60, manufactured from a split cobble. Cortex material working edge.

b. Specimen 61, manufactured from a split cobble. Cortex material working edge.

c. Specimen 62, manufactured from a split cobble. Interior material working edge.

d. Specimen 63, manufactured on a large flake

e. Specimen 64, manufactured on a large flake

f. Specimen 65, manufactured on a large flake

g. Specimen 66, manufactured on a large flake

PLATE 6

PLATE 7

HAMMERSTONES, ANVILS, AND MILLING STONES

a. Specimen 67, hammerstone

b. Specimen 68, hammerstone

c. Specimen 69, hammerstone

d. Specimen 70, hammerstone

e. Specimen 71, hammerstone

f. Specimen 72, anvil

g. Specimen 73, anvil

h. Specimen 74, anvil

i. Specimen 75, anvil

j. Specimen 76, milling stone

k. Specimen 77, milling stone

PLATE 7

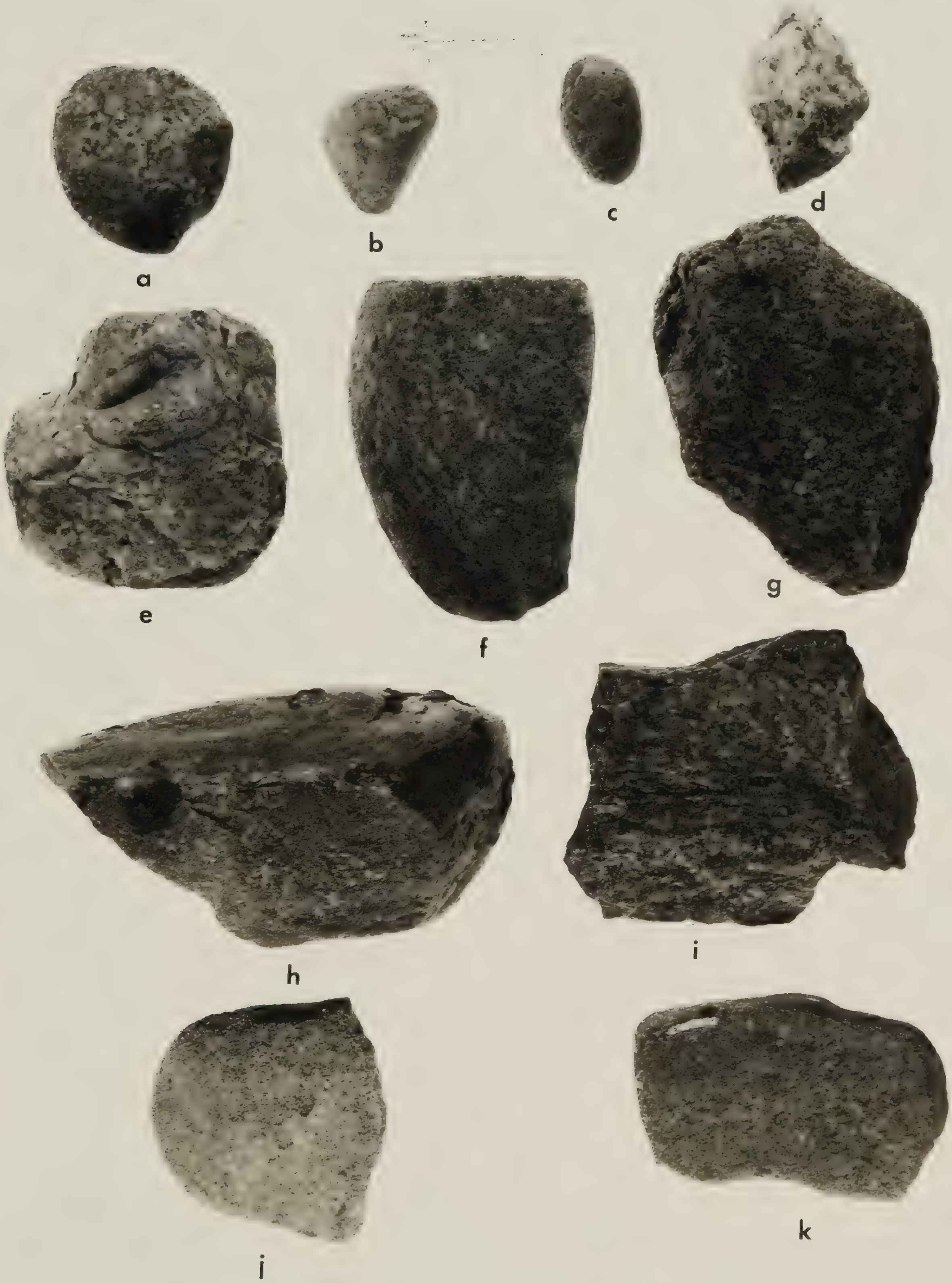


PLATE 8

PIÈCES ESQUILLÉES AND BIPOLAR SPLIT PEBBLES

a. Specimen 42, pièces esquillées

b. Specimen 43, pièces esquillées

c. Specimen 44, pièces esquillées

d. Specimen 45, pièces esquillées

e. Specimen 78, bipolar split pebble

f. Specimen 79, bipolar split pebble

g. Specimen 80, bipolar split pebble

h. Specimen 81, bipolar split pebble

i. Specimen 82, bipolar split pebble

PLATE 8

PLATE 9

LARGE CORES, CORE FRAGMENTS AND OCHRE

a. Specimen 83, core

b. Specimen 84, core

c. Specimen 85/86/87, reconstructed core

d. Specimen 88, ochre sample

PLATE 9

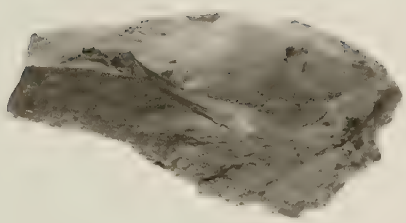
PLATE 10

BONE AND ANTLER TOOLS

a. Specimen 89, retouched bone flake

b. Specimen 90, modified antler tine

PLATE 10



a

b

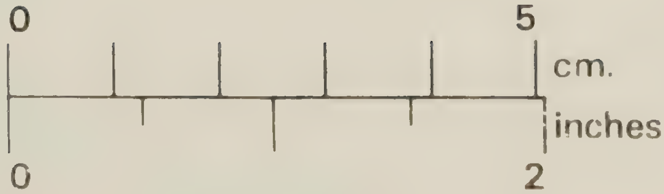


PLATE 11

Comparison of a modern *Bison bison athabascae* rib (a) to (b) a proximal fragment recovered from the first occupation of the Boss Hill Site, Locality 2.

PLATE 11

PLATE 12

Projectile Points Excavated From The Fullerton Site FfPi 1.

PLATE 12

PLATE 13

Projectile Points From The Gwynne Tower Site,

FgPh 1

PLATE 13

PLATE 14

Projectile Points From Selected Sites in the Drayton Valley Area, Alberta.

PLATE 14

APPENDIX I

ASPEN PARKLAND CHECKLIST: FLORA OF THE BUFFALO LAKE AREA

Compiled by C.D. Bird for the southwest shore with Boss Hill Site (east shore). Species Identification and Ethnobotanical Annotations by Julie O. Hrapko, Curator of Botany, Provincial Museum of Alberta.

(* denotes species common to both areas)

(@ denotes species from the Boss Hill Site only)

FUNGI

Powdery Mildew (Uncinula salicis)

Cup fungus (Peziza "Arvenensis")

Black-ridged Morel (Morchella angusticeps)

Light-ridged, dark-pitted Morel (M. deliciosa)

Edible Bolete (Boletus edulis)

Bolete (Leccinum insigne)

Lactarius uvidus

Fly Agaric (Amanita Muscaria)

Shaggy Mane or Inky Cap (Coprinus comatus)

Fairy Ring Mushroom (Marasmius sp.)

Oyster Mushroom (Pleurotus ostreatus)

Giant Puffball (Calvatia sp.)

Puffball with apical pore (Lycoperdon sp.)

Earth Star (Geastrum sp.)

Bird's-nest Fungus (Cyathus olla)

LICHENS

Peltigera rufescens

Cladonia chlorophaea

C. fimbriata

C. subulata

Candelariella aurella

Parmelia albertana

P. exasperatula

P. flaventior

P. sulcata

Bryoria fuscescens

Evernia mesomorpha

Usnea perplectans

Physcia adscendens

P. aipolia

P. dubia

P. orbicularis

P. stellaris

Ramalina sp.

Caloplaca holocarpa

C. murorum

Xanthoria fallax

X. polycarpa

LIVERWORTS

Marchantia polymorpha

MOSSES

Polytrichum juniperinum

Ceratodon purpureus

Tortula ruralis

Funaria hygrometrica

Bryum sp.

Rhizomnium cuspidatum

Timmia sp.

Amblystegium sp.

Brachythecium salesbrosum

Hylocomium splendens

Hynum cupressiforme

Pylaisiella polyantha

Drepanocladus aduncus var. polycarpus

D. vernicosus

Pleurozium schreberi

FERNS & FERN ALLIES

EQUISETACEAE

Horsetail (Equisetum arvense)

Common Horsetail (Equisetum arvense)

Loose-sheathed Scouring Rush (E. laevigatum)

CONIFERS

PINACEAE

Ground Juniper (Juniperus communis)

Creeping Juniper (J. horizontalis)

White spruce (Picea glauca)

VASCULAR PLANTS

MONOCOTS

TYPHACEAE

Common cattail (Typha latifolia) - food, technology

SPARGANIACEAE

Many-stalked Bur-reed (Sparganium multipedunculatum)

NAJADACEA

Sago Pondweed (Potamogeton pectinatus) - food

Richardson's Pondweed (P. richardsonii)

Sheathed Pondweed (P. vaginatus)

JUNCAGINACEAE

Seaside Arrow-grass (Triglochin maritima) - food
(seed after treatment)

GRAMINEAE

Quack Grass (Agropyron repens)

Awned Wheat Grass (A. subsecundum)

Western Wheat Grass (A. trachycaulum)

* Rough Hair Grass (Agrostis scabra)

* Water Foxtail (Alopecurus aequalis)

Wild Oats (Avena fatua)

Slough Grass (Beckmannia syzigachne)

Blue Grama Grass (Bouteloua gracilis)

Fringed Brome (Bromus ciliatus)

Awnless Brome (B. inermis)

* Northern Reed Grass (Calamagrostis inexpansa)

* Alkali Grass (Distichlis stricta)

Barnyard Grass (Echinochloa pungens)

* Rough Fescue (Festuca scabrella)

* Sweet Grass (Hierochloe odorata)

* Foxtail Barley (Hordeum jubatum)

Barley (H. vulgare)

June Grass (Koeleria cristata)

Timothy (Phleum pratense)

Inland Bluegrass (Poa interior)

Kentucky Bluegrass (P. pratensis)

Reed Grass (Phragmites communis)

* Nuttall's Alkali Grass (Puccinella nuttalliana)

Rye (Secale cereale)

* Green Foxtail or Wild Millet (Setaria viridis) - food

* Alkali Cord Grass (Spartina gracilis)

Spear Grass (Stipa spartea var. curtiseta) - hairbrush

Green Needle Grass (S. viridula)

* Golden Sedge (Carex aurea)

* Dry-spike Sedge (C. foenea)

Hairy-fruited Sedge (C. lasiocarpa)

Blunt Sedge (C. obtusata)

Beaked Sedge (C. rostrata)

Green Sedge (C. viridula)

* Needly Spike Rush (Eleocharis acicularis)

* Creeping Spike Rush (E. palustris)

* Three-square Rush (Scirpus americanus)

* S. nevadensis

* Common Great Bulrush (S. validus) - food

LEMNACEAE

Common Duckweed (Lemna minor)

Ivy-leaved Duckweed (L. trisulca)

JUNCACEAE

Alpine Rush (Juncus alpinus var. tariflorus)

* Wire Rush (J. balticus var. montanus) - dye

* Toad Rush (J. bufonius)

Path Rush (J. tenuis)

LILIACEAE

Prairie Onion (Allium textile) - food

* Fairy Bells (Disporum trachycarpum)

* Western Wood Lily (Lilium philadelphicum var. andinum)

* Wild Lily of the Valley (Maianthemum canadense var. interius)

False Solomon's seal (Smilacina racemosa var. amplexicaulis) - medicinal

* Star-Flowered Solomon's seal (S. stellata) - medicine

IRIDACEAE

* Blue-eyed Grass (Sisyrinchium montanum)

ORICHIDACEAE

* Pale Coral-root (Corallorhiza trifida)

Yellow Lady's Slipper (Cypripedium calceolus var. pubescens)

DICOTS

SALICACEAE

* Balsam Poplar (Populus balsamifera) - chiefly technology, medicine

* Aspen (P. tremuloides) - chiefly technology

* Bebb's Willow (Salix bebbiana)

* Pussy Willow (S. discolor) - medicine, dye

Grey Willow (S. glauca)

* Sandbar Willow (S. interior)

Meadow Willow (S. petiolaris)

BETULACEAE

Water Birch (Betula occidentalis) - dye

* Paper Birch (B. papyrifera) - technology

URTICACEAE

* Common Nettle (Urtica gracilis) - medicine

SANTALACEAE

Pale Comandra (Comandra pallida)

POLYGONACEAE

Striate Knotweed (Polygonum achoreum)

Water Smartweed (P. amphibium var. stipulaceum)

* Doorweed (P. aviculare)

Wild Buckwheat (P. convolvulus)

Pale Persicaria (P. lapathifolium)

Golden Dock (Rumex maritimus var. fueginus)

CHENOPODIACEAE

Nuttall's Atriplex (Atriplex nuttallii)

* Russian Pigweed (Axyris amaranthoides)

Lamb's-quarters (Chenopodium album)

Fermont's Goosefoot (C. fremontii)

Oak-leaved Goosefoot (C. glaucum ssp. salinum)

Red Goosefoot (C. rubrum)

@ Bugseed (Corispermum hyssopifolium)

* Sea Blite (Suaeda depressa)

AMARANTHACEAE

Red Root Pigweed (Amaranthus retroflexus)

PORTULACACEAE

Portulaca (Portulaca oleracea)

CARYOHPYLLACEAE

* Blunt-leaved Sandwort (Arenaria lateriflora)

* Field Chickweed (Cerastium arvense)

White Cockle (Lychnis alba)

Thick-leaved Chickweed (Stellaria crassifolia)

* Long-stalked Chickweed (S. longipes)

Common Chickweed (S. media)

RANUNCULACEAE

* Baneberry (Actaea rubra) - medicine

* Canada Anemone (Anemone canadensis)

* Long-fruited Anemone (A. cylindrica)

* Cut-leaved Anemone (A. multifida) - medicine

* Prairie Crocus (A. patens var. wolfgangiana) - medicine

@ Blue Clematis (Clematis verticellaris var. columbiana)

* Small-fruited Buttercup (Ranunculus aboritvus)

* Alkali Buttercup (R. cymbalaria)

* Prairie Buttercup (R. rhomboideus)

Celery-leaved Buttercup (R. sceleratus)

* Veiny Meadow Rue (Thalictrum venulosum)

FUMARIACEAE

* Golden Corydalis (Corydalis aurea)

CRUCIFERAE

* Purple Rock Cress (Arabis divaricarpa)

Horse Radish (Armoracia rusticana)

Charlock (Bassica kaber var. pinnatifida)

* Shepherd's purse (Capsella bursa-pastoris)

Grey Tansy Mustard (Descurainia richardsonii)

* Flixweed (D. sophia)

* Annual Draba (Draba nemorosa var. leiocarpa)

Wormseed Mustard (Erysimum cheiranthoides)

Small-flowered Prairie Rocket (E. inconspicuum)

* Common Peppergrass (Lepidium densiflorum)

* Ball Mustard (Neslia paniculata)

Yellow Cress (Rorippa islandica)

Yellow Cress (R. obtusa)

* Stinkweed (Thlaspi arvense)

SAXIFRAGACEAE

Alum-root (Heuchera richardsonii) - medicine

Grass-of-Parnassus (Parnassia palustris var. neogaea)

* Wild Black Currant (Ribes americanum) - food, medicine

* Wild Gooseberry (R. oxyancanthoides) - food

ROSACEAE

* Agrimony (Agrimonia striata)

* Saskatoon (Amelanchier alnifolia) - food, technology (Wood)

* Wild Strawberry (Fragaria virginiana var. glauca) - food, medicine

Yellow Avens (Geum allepicum var. strictum)

Three-flowered Avens (G. triflorum)

* Silverweed (Potentilla anserina) - food (root)

Early Cinquefoil (P. concinna)

* Graceful Cinquefoil (P. gracilis)

* Prairie Cinquefoil (P. pensylvanica)

@ Rough Cinquefoil (P. novegica)

* Pin Cherry (Prunus pensylvanica) - food, medicine, technology (wood)

* Choke-cherry (P. virginiana var. melanocarpa) - as above

* Prickly Rose (Rosa acicularis) - medicinal, food

* Common Wild Rose (R. Woodsii) - medicinal, food

* Dewberry (Rubus pubescens) - food

* Wild Red Raspberry (R. strigosus) - food, medicine

White Meadowsweet (Spiraea alba)

LEGUMINOSAE

* Purple Mild Vetch (Astragalus agrestis)

Canadian Milk Vetch (A. canadensis) - food (roots)

Slender Milk Vetch (Astragalus agrestis)

Ascending Purple Milk Vetch (A. striatus)

Caragana (Caragana arborescens)

* Alpine Hedysarum (Hedysarum alpinum) - food

* Yellow Pea Vine (Lathyrus ochroleucus)

Alfalfa (Medicago falcata)

White Sweet Clover (Melilotus alba)

Yellow Sweet Clover (M. officinalis)

Late Yellow Locoweed (Oxytropis campestris) - medicine (poisonous)

Viscid Locoweed (O. viscida)

* Golden Bean or Buffalo Bean (Thermopsis rhombifolia)

Alsike Clover (Trifolium hybridum)

White Clover (T. repens)

* American Vetch (Vicia americana)

ACERACEAE

Manitoba Maple (Acer negundo var. interius)

MALVACEAE

Round-leaved Mallow (Malva rotundifolia)

VIOLACEAE

* Early Blue Violet (Viola adunca)

Bog Violet (V. nephrophylla)

Crowfoot Violet (V. pedatifida)

@ Western Canada Violet (V. rugulora)

ELAEAGNACEAE

* Wolf Willow (Elaeagnus commutata) - beads

* Canada Buffalo-berry (Shepherdia canadensis) - food

LYTHRACEAE

Fringed Loosestrife (Lysimachia ciliata)

Tufted Loosestrife (L. thyrsiflora)

ONAGRACEAE

* Fireweed (Epilobium augustifolium) - medicine

Northern Willow-herb (E. glandulosum)

* Yellow Evening Primrose (Oenothera biennis) - food

HALORAGIDACEAE

* Water Milfoil (Myriophyllum exalbescens)

ARALIA

* Wild Sarsaparilla (Aralia nudicaulis) - medicine

UMBELLIFERAE

Bulb-bearing Water Hemlock (Cicuta bulbifera) - suicide

* Cow Parsnip (Heracleum lanatum) - medicine

* Sweet Cicely (Osmorhiza depauperata) - edible (roots)

Snake-root (Sanicula marilandica)

Water Parsnip (Sium suave)

* Heart-leaved Alexanders (Zizia aptera)

CORNACEAE

@ Bunchberry (Cornus canadensis)

* Red Osier Dogwood (Cornus stolonifera) - smoking, dye

PYROLACEAE

* Common Pink Wintergreen (Pyrola asarifolia)

White Wintergreen (P. elliptica)

* One-sided Wintergreen (P. secunda)

MONOTROPACEAE

@ Indian Pipe (Monotropa uniflora)

ERICACEAE

* Common Bearberry (Arctostaphylos uva-ursi) - smoking

PRIMULACEAE

Fairy Candelabra (Androsace septentrionalis)

Shooting Star (Dodecatheon radicatum)

* Sea Milkwort (Glaux maritima)

Mealy Primrose (Primula incana)

GENTIANACEAE

* Felwort (Gentianella amarella ssp. acuta)

POLEMONIACEAE

* Collomia (Collomia linearis)

BORAGINACEAE

@ Stick-seed (Hackelia floribunda)

* Blue-bur (Lappula echinata)

@ Lungwort (Mertensia paniculata)

LABIATAE

@ Giant Hyssup (Agastache foeniculum)

Hemp Nettle (Galeopsis tetrahit)

Henbit (Lamium amplexicaule)

Western Water-horehound (Lycopus asper)

* Wild mint (Mentha arvensis var. villosa) - tea, medicine

* Wild Bergamot (Monarda fistulosa var. menthaefolia) - tea, flavoring, perfume, medicine

Common Skullcap (Scutellaria galericulata)

* Hedge Nettle (Stachys palustris var. pilosa)

SCROPHULARIACEAE

Common Red Paintbrush (Castilleja miniata)

Butter-and-eggs (Linaria vulgaris)

* Owl Clover (Orthocarpus luteus)

Slender Blue Beard-tongue (Penstemon procerus)

OROBANCHACEAE

One-flower Cancer-root (Orobanche uniflora) - medicine

LENTIBULARIACEAE

Common Bladderwort (Utricularia vulgaris var. americana)

PLANTAGINACEAE

Saline Plantain (Plantago eriopoda)

* Common Plantain (P. major) - medicine

RUBIACEAE

* Northern Bedstraw (Galium boreale) - dye

* Small Bedstraw (G. trifidum)

CAPRIFOLIACEAE

* Twining Honeysuckle (Lonicera dioica var. glaucescens)

@ Snowberry (Symphoricarpos albus)

* Western Snowberry or Buckbrush (Symphoricarpos occidentalis) - medicine, technology

@ Lowbush Cranberry (Viburnum edule)

CAMPANULACEAE

* Bluebell (Campanula rotundifolia)

COMPOSITAE

* Common Yarrow (Achillea millefolium ssp. lanulosa) - medicine

Sneezeweed (A. ptarmica)

False Dandelion (Agoseris glauca)

Prairie Pussytoes (Antennaria neglecta)

* Small Everlasting (A. nitida)

Showy Everlasting (A. pulcherrima)

* Wormwood (Artemisia absinthium)

Biennial Sagewort (A. biennis)

* Plains Sagewort (A. campestris)

Dragonwort Sage (A. dracunculus) - medicine

* Pasture Sage (A. frigida)

* Prairie Sagewort (A. ludoviciana var. gnaphalodes) - medicine

* Rayless Aster (Aster brachyactis)

* Lindley's Aster (A. ciliolatus)

@ Showy Aster (A. conspicirus)

* Creeping White Prairie Aster (A. falcatus)

* Western Willow Aster (A. hesperius)

* Smooth Aster (A. laevis var. geyeri)

* Tufted White Prairie Aster (A. pansus)

Nodding Beggar-ticks (Bidens cernua)

* Golden Aster (Chrysopsis villosa)

* Canada Thistle (Cirsium arvense)

* Flodman's Thistle (C. flodmanii)

* Wavy-leaved Thistle (C. undulatum)

* Annual Hawksbeard (Crepis tectorum)

Horseweed (Erigeron canadensis)

* Smooth Fleabane (E. glabellus)

Brown-eyed Susan (Gaillardia aristata)

Marsh or Low Cudweed (Gnaphalium palustre)

* Gumweed (Grindelia squarrosa) - medicine

Rhombic leaved Sunflower (Helianthus laetiflorus var. subrhomoideus) - oil

Canada Hawkweed (Hieracium canadense)

* Wild Blue Lettusc (Lactuca pulchella)

Blazing Star (Liatris ligulistylis)

Pineapple Weed (Matricaria matricarioides) - medicinal

Arrow-leaved Coltsfoot (Petasites sagittatus) - food

Marsh Ragwort (Senecio congestus)

* Cut-leaved Ragwort (S. eremophilus)

Rayless Ragwort (S. indecorus)

Common Groundsel (S. vulgaris)

* Mountain Goldenrod (Solidago decumbens)

* Late Goldenrod (S. gigantea)

Flat-topped Goldenrod (S. graminifolia)

* Low Goldenrod (S. missouriensis)

Stiff Goldenrod (S. rigida var. humilis)

* Perennial Sowthistle (Sonchus arvensis)

Spiny Annual Sowthistle (S. asper)

* Perennial Sowthistle (S. uliginosus)

* Common Dandelion (Taraxacum officinale)

* Goat's-beard (Tragopogon dubius)

APPENDIX II

VOLCANIC ASH ANALYSIS

BY PAM WATERS, DEPARTMENT OF GEOLOGY, UNIVERSITY OF ALBERTA.

BOSS HILL SITE FdPe 4 LOCALITY 2

SAMPLE #3A ASH

DATE AND TIME PROCESSED: MON JUL 28/80 12:31:35
17/25 SHARDS MAZAMA

ELEMENT	STANDARD USED	RESULTS	OXID	DLET	OXID
H		1.097	2.807	0.0	0.0
O		52.542		48.598	
NA	211	3.823	5.153	4.239	5.713
MG	87	0.281	0.466	0.311	0.516
AL	211	7.066	13.350	7.834	14.802
SI	211	30.404	65.043	33.710	72.115
K	279	2.135	2.572	2.367	2.851
CA	87	0.936	1.310	1.038	1.452
TI	163	0.238	0.397	0.264	0.440
MN	269	0.036	0.047	0.040	0.052
FE	163	1.442	1.855	1.599	2.286

SAMPLE #3A ASH

DATE AND TIME PROCESSED: MON JUL 28/80 12:31:35

OPTIONS: 000001
End of Loop # 1
End of Loop # 2
End of Loop # 3
End of Loop #4

Z	A	FL	FC	ZAF	RAW-C	CORR-C	ST VAL	WT FR	EL	EO
1.0264	1.6571	0.9965	1.0000	1.0302	3628	171020	0.1319	0.03823	NA	15.0
0.9999	1.3981	0.9925	1.0000	1.0419	599	21592	0.0938	0.00281	MG	15.0
1.0332	1.2187	0.9879	1.0000	1.0307	10078	465580	0.1220	0.07066	AL	15.0
1.0097	1.1825	0.9996	1.0000	1.0249	9045	433745	0.5873	0.30404	SI	15.0
1.1016	1.0542	0.9980	1.0000	1.0174	2491	113797	0.1619	0.02135	K	15.0
1.0851	1.0395	0.9991	1.0000	1.0285	1536	54728	0.1518	0.00936	CA	15.0
1.2053	1.0159	0.9980	1.0000	1.0303	115	4210	0.4629	0.00238	TI	15.0
1.2564	1.0011	0.9993	1.0000	1.0854	56	630	0.4586	0.00036	MN	15.0
1.2417	0.9991	1.0000	1.0000	1.0283	438	19097	0.6088	0.01442	FE	15.0

SPECIAL OPERATIONS USED
AJST TYPE: ZERO OFAC MOLE
CALC TYPE: OXID DLET OXID

THE TOTAL OF ALL ELEMENTS IS 100.00%
THE TOTAL OF OTHER ANIONS IS 0.00%
THE TOTAL AFTER CORRECTION FOR OTHER ANIONS IS 100.00%
THE TOTAL WEIGHT OF THE ELEMENTS REMOVED WAS 9.81%
THE TOTAL OF OTHER ANIONS IS 0.0%
THE TOTAL AFTER CORRECTION FOR OTHER ANIONS IS 100.00%

SAMPLE #3B ASH

DATE AND TIME PROCESSED: MON JUL 28/80 12:31:35
8/25 SHARDS MAZAMA

ELEMENT	STANDARD USED	RESULTS	OXID	DLET	OXID
H		1.190	10.637	0.0	0.0
O		53.032		48.774	
NA	211	3.278	4.419	3.668	4.945
MG	87	0.280	0.464	0.313	0.519
AL	211	7.051	13.323	7.890	14.909
SI	211	30.375	64.981	33.990	72.716
K	279	2.290	2.759	2.563	3.087
CA	87	0.938	1.312	1.049	1.468
TI	163	0.239	0.398	0.267	0.445
MN	269	0.036	0.047	0.041	0.053
FE	163	1.291	1.661	1.445	2.064

SAMPLE #3B ASH

DATE AND TIME PROCESSED: MON JUL 28/80 12:31:35.

OPTIONS: 000001
End of Loop #1
End of Loop #2
End of Loop #3
End of Loop #4

Z	A	FL	FC	ZAF	RAW-C	CORR-C	ST VAL	WT FR	EL	EO
1.0278	1.6597	0.9965	1.0000	1.0332	3113	146229	0.1319	0.03278	NA	15.0
1.0012	1.3916	0.9924	1.0000	1.0384	599	21592	0.0938	0.00280	MG	15.0
1.0346	1.2147	0.9878	1.0000	1.0286	10078	465580	0.1220	0.07051	AL	15.0
1.0111	1.1799	0.9996	1.0000	1.0239	9045	433745	0.5873	0.30375	SI	15.0
1.1031	1.0537	0.9981	1.0000	1.0184	2661	121963	0.1619	0.02290	K	15.0
1.0866	1.0396	0.9991	1.0000	1.0301	1536	54728	0.1518	0.00938	CA	15.0
1.2069	1.0160	0.9982	1.0000	1.0320	115	4210	0.4629	0.00239	TI	15.0
1.2582	1.0012	0.9993	1.0000	1.0871	56	630	0.4586	0.00036	MN	15.0
1.2435	0.9991	1.0000	1.0000	1.0298	396	17068	0.6088	0.01291	FE	15.0

SPECIAL OPERATIONS USED
AJST TYPE: ZERO OFAC MOLE
CALC TYPE: OXID DLET OXID

THE TOTAL OF ALL ELEMENTS IS 100.00%
THE TOTAL OF OTHER ANIONS IS 0.00%
THE TOTAL AFTER CORRECTION FOR OTHER ANIONS IS 100.00%
THE TOTAL WEIGHT OF THE ELEMENTS REMOVED WAS 10.64%
THE TOTAL OF OTHER ANIONS IS 0.0%
THE TOTAL AFTER CORRECTION FOR OTHER ANIONS IS 100.00%

APPENDIX III

MAMMALS OF THE BUFFALO LAKE AREA

This list consists of those species observed by Dr. C.D. Bird on the southwest side of Buffalo Lake and those observed by the author on the northeast side. Observed species also present in the archaeological record are indicated by an asterisk (*). Species found exclusively in the archaeological record are indicated by @.

Masked Shrew (Sorex cinereus)

Little Brown Bat (Myotis lucifugus)

* White-tailed Jack Rabbit (Lepus townsendii) - food

* Snowshoe Hare (L. americanus) - food

Woodchuck (Marmota monax)

* Richardson's Ground Squirrel (Spermophilus richardsonii) - intrusive

* Thirteen-lined Ground Squirrel (S. tridecimlineatus) - intrusive

* Franklin's Ground Squirrel (S. franklinii) - intrusive

Least Chipmunk (Eutamias minimus)

* Northern Pocket Gopher (Thomomys talpoides) - intrusive

* Beaver (Castor canadensis) - food and other

House Mouse (Mus musculus)

* Deer Mouse (Peromyscus maniculatus) - intrusive

* Meadow Vole (Microtus pennsylvanicus) - intrusive

* Muskrat (Ondatra zibethicus) - food and other

Western Jumping Mouse (Zapus princeps)

* Porcupine (Erethizon dorsatum) - food and other

Coyote (Canis latrans)

@ Swiftfox (Vulpes velox) - food

@ Black bear (Ursus americanus) - other

Ermine (Mustela erminea)

Least Weasel (M. nivalis)

Long-tailed Weasel (M. frenata)

* Badger (Taxidea taxus) - good

Plains Skunk (Mephitis mephitis)

@ Wapiti (Cervus canadensis) - food, tools, other

Mule Deer (Odocoileus hemionus)

White-tailed Deer (O. virginianus dacotensis)

@ Moose (Alces alces) - food, other

@ Pronghorned antelope (Antilocapra americanus) - food, other

@ Plains Bison (Bison bison) - food, tools, other

APPENDIX IV

BIRDS OF THE BUFFALO LAKE AREA

Compiled from Fish and Wildlife Division of Alberta Energy and Natural Resources Records; Observations of Dr. C.D. Bird and the author's observations.

* indicates those species found in the archaeological record at Buffalo Lake.

SPECIES	STATUS	PREFERRED HABITAT
Common Loon	Summer resident	large, deep lakes
Red-necked Grebe	Summer resident	larger sloughs & lakes
Horned Grebe	common summer resident	deep sloughs & lakes
Eared Grebe	common summer resident	large ponds & lakes
Western Grebe	uncommon summer resident	large ponds & lakes
Pied-billed Grebe	uncommon summer resident	deep sloughs
White Pelican	rare visitor	lakes
Great Blue Heron	summer resident	colony on island
Black-crowned Night Heron	uncommon	
American Bittern	summer resident	cattail sloughs
Whistling Swan	spring and fall migrant	large sloughs & lakes
Canada Goose	common resident & migrant	lakes & large sloughs
(A) Brant (Black Brant)	migrant	lakes & large sloughs
* White-fronted Goose	migrant	lakes & large sloughs
* Snow (Blue) Goose	migrant	lakes & large sloughs
Ross' Goose	migrant	lakes & large sloughs
* Mallard	common resident & migrant	lakes & large sloughs, potholes

SPECIES	STATUS	PREFERRED HABITAT
* Gadwall	common resident & migrant	small & large sloughs
* Pintail	common resident & migrant	small & large sloughs
Green-winged Teal	common resident & migrant	small & large sloughs
* Blue-winged Teal	common resident & migrant	small & large sloughs
Cinnamon Teal	occasional resident & migrant	small & large sloughs
American Widgeon	common resident & migrant	small & large sloughs
Shoveler	common resident & migrant	small & large sloughs
(A) Wood Duck	rare migrant	small & large sloughs
* Redhead	common resident & migrant	deep ponds and lakes
Ring-necked Duck	uncommon resident & migrant	deep ponds and lakes
Canvasback	resident & migrant	deep ponds and lakes
* Lesser Scaup	common resident & migrant	deep ponds & rivers
Common Goldeneye	common resident & migrant	deep ponds & rivers
Bufflehead	common resident & migrant	deep ponds & rivers
White-winged Scoter	common nester & migrant	deep ponds and rivers
* Ruddy Duck	summer resident	cattail sloughs
Hooded Merganser	migrant	large lakes
Common Merganser	summer resident	large lakes
Red-breasted Merganser	occasional resident	large lakes
Turkey Vulture	rare sightings	river badlands
Goshawk	common	treed areas
Sharp-shinned Hawk	common	brushy areas
Cooper's Hawk	uncommon	brushy areas
* Red-tailed (Harlan's) Hawk	common resident	open lands/ forest edges

SPECIES	STATUS	PREFERRED HABITAT
Swainson's Hawk	common resident	open lands; forest edges
Rough-legged Hawk	regular migrant	
Ferruginous Hawk	occasional visitor	prairie
Golden Eagle	fall & spring migrant	
Bald Eagle	fall & spring migrant	
Marsh Hawk	summer resident	marshes, lowlands
Osprey	occasional visitor	lake
Gyrfalcon	occasional visitor	
Prairie Falcon	occasional visitor	
Peregrine Falcon	summer resident	river
Pigeon Hawk	occasional visitor	lake
Sparrow Hawk	spring & fall migrant	partly wooded areas
* Ruffed Grouse	common resident	aspen forest
* Sharp-tailed Grouse	uncommon resident	prairie
Ring-necked Pheasant	introduced resident	brushy areas
Grey Partridge	uncommon resident	
Sandhill Crane	migrant	lakes
Sora	common resident	sedge, cattail, marsh
American Coot	common summer resident	sloughs, marshes
Semipalmated Plover	migrant	
Piping Plover	rare nester	shorelines
Killdeer	common resident	unvegetated shorelines
Ruddy Turnstone	migrant	lakeshores, splash zone
Common Snipe	common resident	lakeshores, lowlands
Upland Plover	migrant	

SPECIES	STATUS	PREFERRED HABITAT
Spotted Sandpiper	common resident	lakeshores, lowlands
Willet	common resident	mudflats, shallow ponds & lakes
Greater Yellowlegs	common migrant	lakeshores, ponds
Lesser Yellowlegs	common migrant & nester	lakeshores, ponds
Pectoral Sandpiper	migrant	
White-rumped Sandpiper	migrant	
Baird's Sandpiper	migrant	
Least Sandpiper	migrant	
Long-billed Dowitcher	migrant	
Semipalmated Sandpiper	migrant	
Marbled Godwit	uncommon resident	mudflats, shallows
Sanderling	migrant	mudflats, shallows
American Avocet	summer resident	shallow ponds, mudflats & shores
Wilson's Phalarope	common migrant	shallow ponds, mudflats & shores
Herring Gull	migrant	lakes & rivers
California Gull	summer resident	colony on lake
Ring-billed Gull	summer resident	colony on lake
Franklin's Gull	summer resident	lakes
Bonaparte's Gull	summer resident	
Common Tern	summer resident	lakes
Black Tern	common resident	ponds with protected island, well vegetated
(A) Band-tailed Pigeon	rare visitor	deciduous forests

SPECIES	STATUS	PREFERRED HABITAT
Rock Dove	summer resident	woodlands
Mourning Dove	summer resident	woodlands
Black-billed Cuckoo	occasional summer visitor	wooded areas
Great Horned Owl	common resident	wooded areas
Snowy Owl	winter visitor	fencelines, fields
Hawk Owl	winter visitor	
Burrowing Owl	summer nester	burrows (badger)
Great Grey Owl	rare visitor	
Long-eared Owl	resident	wooded areas (new lake)
Short-eared Owl	resident -	
Boreal Owl	occasional visitor	
Saw-whet Owl	summer resident	
Common Nighthawk	summer resident	river banks
Ruby-throated-Humming-bird	summer resident	flower gardens
Rufous Hummingbird	scarce	
Belted Kingfisher	common summer resident	rivers
Yellow-bellied Sap-sucker	resident	deciduous forest
Yellow-shafted Flicker	common summer resident	mature deciduous forest
Red-shafted Flicker	uncommon	mature deciduous forest
Pileated Woodpecker	resident (occasional)	mature deciduous forest
Hairy Woodpecker	common resident	deciduous forest
Downy Woodpecker	common resident	deciduous forest
Eastern Kingbird	common resident	deciduous stands

SPECIES	STATUS	PREFERRED HABITAT
Western Kingbird	occasional resident	deciduous stands
Eastern Phoebe	common resident	deciduous forests
Say's Phoebe	occasional resident	
Least Flycatcher	common summer resident	deciduous forests
Western Wood Pewee	common summer resident	deciduous forest
Horned Lark	common summer resident	open fields, deciduous forest
Tree Swallow	common summer resident	deciduous forests, buildings
Bank Swallow	common summer resident	cutbanks
Rough-winged Swallow	uncommon	
Barn Swallow	common summer resident	brush & buildings
Cliff Swallow	common summer resident	cliffs, bridges, cutbanks
Purple Martin	common summer resident	building, deciduous forest
Grey Jay	occasional sighting	
Blue Jay	common resident	deciduous woods
Steller's Jay	rare	
Black-billed Magpie	common resident	deciduous forest
Common Raven	uncommon	deciduous trees
Common Crow	common resident	deciduous trees
Black-capped Chickadee	common resident	deciduous forest
Mountain Chickadee	uncommon	deciduous forest
Red-breasted Nuthatch	occasional	deciduous torest
House Wren	common resident	deciduous forest edges
Long-billed Marsh Wren	common resident	marshes
(A) Mockingbird	rare	

SPECIES	STATUS	PREFERRED HABITAT
Catbird	common summer resident	chokecherry bushes
Brown Threasher	occasional summer resident	
Robin	common summer resident	
Swainson's Thrush	occasional migrant	
Veery	common summer resident	river flats
Mountain Bluebird	common summer resident (increasing)	nest boxes
Townsend's Solitaire	rare	
Golden-crowned Kinglet	occasional visitor	
Ruby-crowned Kinglet	occasional visitor	
Water Pipit	regular migrant	
Sprague's Pipit	common summer resident	open fields
Bohemian Waxwing	common winter/summer	windbreaks
Cedar Waxwing	common summer resident	
Northern Shrike	uncommon resident	thick shrubs (thorny)
Loggerhead Shrike	uncommon resident	thick shrubs (thorny), large deciduous trees
Starling	common resident	
Red-eyed Vireo	uncommon summer resident	
Philadelphia Vireo	uncommon summer resident	
Warbling Vireo	common summer resident	deciduous trees
Tennessee Warbler	uncommon	
Orange-crowned Warbler	occasional resident	
Yellow Warbler	common summer resident	shrubs, forest edges
Myrtle Warbler	migrant	
Audubon's Warbler	occasional migrant	

SPECIES	STATUS	PREFERRED HABITAT
Blackpoll Warbler	occasional migrant	
Ovenbird	occasional migrant	
Yellowthroat	fairly common resident	
House Sparrow		crevices, buildings, nest, boxes
Boblink	occasional summer resident	
Western Meadowlark	common summer resident	fields, grasslands
Yellow-head Blackbird	common summer resident	cattail, bulrush, marsh
Red-winged Blackbird	common summer resident	cattail, bulrush, marsh
Northern Oriole) Baltimore Oriole) Bullock's Oriole)	common summer resident	deciduous forest
Brewer's Blackbird	summer resident	
Common Grackle	common summer resident	shrubs stand, hedgerows
Brown-headed Cowbird	common summer resident	pastures, shrubland
(A) Scarlet Tanager	rare	
Evening Grosbeak	common winter visitor	
Purple Finch	common winter visitor	
Pine Grosbeak	common winter visitor	
Gray-crowned Rosy Finch	occasional winter visitor	
Hoary Redpoll	common winter visitor	
Common Redpoll	common winter visitor	
American Goldfinch		
Pine Siskin	occasional winter & summer visitor	shrubland and often tall willow
White-winged Crossbill	winter visitor	

SPECIES	STATUS	PREFERRED HABITAT
Rufous-sided Towhee	occasional summer visitor	river
Lark Bunting	occasional visitor	
Savannah Sparrow	common summer reisdent	fields, wet grasslands
Baird's Sparrow	occasional summer resident	
Le Conte's Sparrow	common summer resident	sedge meadow, wet grassland
Vesper Sparrow	common summer resident	grasslands
Lark Sparrow	occasional resident	
Slate-colored Sparrow	common migrant	
Oregon Junco	migrant	
Tree Sparrow	migrant	
Chipping Sparrow	common resident	shrubs
Clay-colored Sparrow	common resident	shrubland, forest edge
Harris' Sparrow	occasional migrant	
White-throated Sparrow	occasional summer resident	
Song Sparrow	common summer resident	shrublands, ripasian
Lincoln's Sparrow	uncommon	shrublands, ripasian
McCown's Longspur	occasional summer resident	
Lapland Longpur	regular migrant	
Smith's Longspur	occasional migrant	
Snow Bunting	common winter visitor	roadsides, pastures

APPENDIX V

SNAILS, FISH, AMPHIBIANS AND REPTILES OF THE BUFFALO LAKE AREA

This list combines those species observed by Dr. C.D. Bird from southwest Buffalo Lake and those of the author from northeast Buffalo Lake. Observed species also found in the archaeological record are indicated by an asterisk (*) while those exclusive to the archaeological record are indicated by @.

SNAILS

* Gyraulus parvus (Say)

Helisoma subcrenatum

@ Helisoma trivolvis (Say)

@ Succinea avana (Say)

@ Lymnaea caperata (Say)

@ Lymnaea obrussa (Say)

Lymnaea stagnalis

@ Retinella electrina (Gould)

@ Physa anatina (Lea)

@ Promenetus exacuous (Say)

Stagnicola palustris

@ Cionella lubrica lubrica (Muller)

FISH

White Sucker (Catostomus commersoni)

Brook Stickleback (Culea inconstans)

Northern Pike (Esox lucius)

Burbot, Ling or Dogfish (Lota lota)

Spottail Shiner (Notropis hudsonius)

Flathead Minnow (Pimephales promelas)

AMPHIBIANS AND REPTILES

Blotched Tiger Salamander (*Ambystoma tigrinum melanostictum*)

* Boreal Toad (*Bufo boreas boreas*)

Boreal Chorus Frog (*Pseudacris nigrita septentrionalis*)

Leopard Frog (*Rana pipiens*)

Wood Frog (*R. Sylvatica*)

Wandering Garter Snake (*Thamnophis elegans vagrans*)

APPENDIX VI

PALYNOLOGICAL AND SEDIMENTOLOGICAL ANALYSIS OF THE BOSS HILL SITE: FdPe 4

by K. Walde

ABSTRACT

A total of ten sediment samples were processed for pollen analysis and thirty-four samples were processed for sedimentological analysis. These samples were collected from stratigraphic profiles at Localities 1 and 2, Boss Hill Archaeological Site on the east end of Buffalo Lake, Alberta.

The processed pollen samples were sterile of Quaternary pollen grains except for sample # 0N2E-70 cm. which contained sufficient palynomorphs for counting. The pollen represented in this sample are predominently Artemisia and Symphoricarpos occidentalis type. These species are still represented in the area today.

The sedimentological analysis demonstrates that the samples processed from Locality 2 are: Clayey Silts (19), (59%); Sandy Clay (7), (21%); Silty Sand (4), (13%); Silty Clay Sand (1), (3%); and Silt (1), (3%).

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INTRODUCTION

This report presents the results of a palynological and sedimentological analysis of sediment samples collected at the Boss Hill Archaeological Site (FdPe 4; SW 1/4, S11, T41, R20, W 4th M.). The samples were collected by Maurice Doll, Archaeologist for the Provincial Museum of Alberta During his 1978 and 1980 field seasons.

The site is located on the north facing slope of a moraine plateau (Boss Hill) between Buffalo and Boss Lakes. Boss Hill is the highest topographic feature within the moraine plateau and is described by Stalker (1960) as an ice-pressed feature containing stratified sediments of sands, silts, and clays. The stratigraphy at Locality 2, from which the bulk of the samples were obtained, is predominately stratified colluvial sediments whereas Locality 1, from which two of the pollen samples (ON2E-70, ON2E-140) were collected, is aeolian sands.

SAMPLING

Pollen Samples

Seven pollen samples were obtained in 1980 using an auger, 15 cm. south and 20 cm. west from the southwest corner of Unit 2.5N, 14.5W. Samples were taken at the following levels below the surface: 25-30 cm.; 40-45 cm.; 185 cm.; 280 cm.; 330 cm.; and 360 cm. Samples were refrigerated until processed in November 1980. In addition, two samples were processed from Locality 1; ON2E-70 cm. and ON2E-140 cm. As noted above the two samples are from aeolian deposits.

It is important to note that the sediment matrices from

which the samples were collected have undergone redeposition and threefore are probably contaminated. Consequently none of the samples can be considered good sources for obtaining viable palaeo-ecological information. A description of these samples is presented in Figure 1.

Soil Samples

According to the field notes, thirty-four, 200 gram samples, were taken from a 3.4 meter profile, 50 cm. east from the southwest corner of the south wall of Unit 2.5S, 14.5W at Locality 2. The profile was cleaned back approximately 10 cm. prior to sampling. The samples were collected from the bottom to the top of the profile in 10 cm. arbitrary levels. The depth was recorded below the surface and tied into a central datum stake at ONOW.

Sample Colour

Sample colour determinations were obtained in the laboratory under consistent lighting conditions. The colour was described and recoded according to the Revised Standard Soil Color Charts (1967). The sample colours from the sediment samples are presented in Figures 4 and 5 and the pollen samples are listed in Figure 1.

PALYNOLOGICAL ANALYSIS

Processing Methodology

Sediment samples were processed according to a modified method developed by Schweger (1976: 93). Fifty gram samples were weighed out and defloculated using a 4% solution of Sodium Pryophos-phate. The sand size class was removed by swirling for one minute and

decanting after 30 seconds thus allowing the sand fraction to settle out of suspension. The supernatant suspension was then poured through a fine mesh screen into a 150 ml. beaker. The concentrated sediment was treated with a few drops of concentrated Hydrochloric Acid in order to remove all carbonates.

The organic fraction was then concentrated and separated from the clay fractions using a Zinc Bromide solution having a specific gravity of 1.9 After centifuging for 20 minutes at 2,000 r.p.m., the heavy liquid was filtered through a fiberglass micropore filter to collect the polleniferious material. Hydrofluoric acid was used to digest the filter paper. Remaining silica colloids were removed with water baths of concentrated Hydrochloric acid. The remaining materials were then subjected to acetolysis and prepared for storage and mounting, c.f. Fraegri and Iversen (1975).

The processed samples were then suspended for storage in 300 lambda of silicone oil. For counting, the concentrated material was thoroughly mixed and then a 25 lambda sample was removed with a Dade Accupette Pipet and mounted on a slide for counting. A sample was considered sterile if the slide contained less than 50 grains per 25 lambda of material. Where the sample was found polleniferous, the colour and condition of each grain was recorded according to a classification scheme modified from Cushing (1976). Slides were counted on a Leitz Laborluz microscope with Periplan eyepieces and 40x and 100x oil Planachromat objectives. Pollen determinations were verified with the aid of the Pollen Reference Collection in the Palaeoenvironmental Laboratory, Department of Anthropology, University of Alberta.

RESULTS

Locality 2

In total, 8 samples were scanned for pollen from Locality 2. All slides were found to be sterile of Quaternary pollen grains. In some of the samples (c.f. Figure 1) a few pre-Quaternary spores were noted.

The sterile condition of the samples is not that surprising because of the nature of the sediments. As noted above, the stratigraphy at Locality 2 is composed of stratified glacially derived colluvial sediments.

Locality 1

The two aeolian samples from Locality 1, which also represented living floors or exposed surfaces upon which people camped, although polleniferous, contained very little pollen.

Two 75 lambda slides of Sample # ON2E-140 cm. and ON2E-70 cm. were scanned. Sample # ON2E-140 cm. did not contain sufficient pollen to justify counting a complete slide. Sample ON2E-70 cm. although not very pollenifierous, contained sufficient grains to record. A Taxon list of the pollen grains noted in Sample # ON2E-70 cm. is present in Figure 2. The colour and condition of the palynomorphs recorded in the slide are presented in the Pollen/Spore Preservation Data Sheet (Figure 3, refers).

Two main pollen types represented in the sample. These are _Artemisia_ and _Symphoricarpos occidentalis_ type (Buckbrush). Species of each pollen type are well represented in the area today. Minor components observed in the sample include sedge and grass.

Aggregates of each pollen type noted above plus those of High Spine Compositae are present. This suggests that species of these types were present in the immediate area during the time period the surface was exposed.

The pollen in the slide was generally not very well preserved. Consequently many Tricolporate and Tricolpate grains could not be identified. Several pre-Quaternary spore were also noted in the sample. In addition, many of the palynomorphs were strongly discoloured suggesting that the pollen grains were subjected to periods of oxidation. Due to the aeolian nature of the deposition the surface probably received palynomorphs from glacially reworked pre-Quaternary sediments.

GRANULOMETRIC ANALYSIS OF THE SEDIMENTS

Hydrometer Analysis

The procedures followed in the preparation and processing of the samples are those presently in use in the Soils Laboratory, Department of Anthropology, University of Alberta (c.f. Folk, 1974).

Samples of approximately 50 grams were accurately weighed using a Mettler P.C. 4400 Delta Range Balance. The samples were dispersed in 125 ml. of 4% calgon solution for 24 hours.

The solutions were agitated in a blender for 2 minutes or longer until all sediments were completely defloculated and then placed in 1000 ml. graduated cylinders to which distilled water was added to the 1000 ml. mark. Readings were recorded at 15 and 30 seconds; 1, 2, 5, 10, 15, and 30 minutes; at 1, 2, 4, 8, and 24 hours.

Temperatures were recorded in a control cylinder after each reading.

Sieve Analysis

On the completion of the hydrometer readings, each suspension was poured through a #230 wet wieve and washed with tap water until the water passing through the sieve became completely clear. The remaining material was then transferred to a beaker and allowed to dry. After drying, the samples were transferred to a series of stacked Canadian Standard Sieves and agitated for fifteen minutes on a Model RX-24 Tyler Portable Sieve Shaker. The following sieve sizes were used: #10, #18, #35, #60, #120, #230, and #270. The weight of each fraction retained on the sieves were then recorded.

RESULTS

Granulometric Results

The particle size distributions were computed using a Fortran Program belonging to Dr. R. May of the Geology Department at the University of Alberta. The combined percentages from the hydrometer and sieve analyses were used to present the granulometric distributions in graphic form using the phi (Ø) scale of measurement (Krumbein, 1934). The data obtained from these analyses are summarized in Figures 4 and 5.

Cumulative Percent Curve and Wentworth Size Classification

The combined percentages from the hydrometer and sieve analyses were then used to obtain a cumulative percent curve diagram

for each sample. Wentworth's (Folk, 1974: 25) grain size classification was followed in order to differentiate the various size classes. Due to the fine nature of the matrices it was not necessary to go beyond the Very Coarse Sand class in presenting the data on the graphs.

Textural Results

Using the data obtained from the granulometric analysis each sample was then categorized according the Shepard's 1954 classification. The results of this classification are presented in Figure 6 and summarized in Figures 4 and 5.

As noted in the diagram, the samples are distinctly clustered with the Clayey Silt to Sandy Clay Silt fractions. The diggerent percentages of samples falling into the various categories are as follows: Clayey Silt, 59%; Sandy Clay Silt, 21%; Silty Sand, 13%; Silty Clay, 3%; and Silt, 3%.

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FIGURE 1

Boss Hill Locality 2: Pollen Samples

DEPTH CM/BS	STANDARD COLOUR	COLOUR DESCRIPTION	COMMENTS
025-030	5YR 2/2	brownish black	Ah Horizon. Nil HCl reaction. No pollen
040-045	7YR 5/2	grayish brown	Silty Sand. Strong HCl reaction. One pre-Quaternary spore noted. Sterile.
185	10YR 7/1	light gray	Clayey Silt. Strong HCl reaction. One pre-Quaternary spore noted. Sterile.
280	10YR 4/2	grayish yellow brown	Clayey Silt. Strong HCl reaction. Sterile.
300-310	10YR 5/3	dull yellowish brown	Clayey Silt. Weak HCl reaction. Sterile.
320	2.5YR 5/2	dark grayish yellow	Clayey Silt. Marly pond deposit. Very strong HCl reaction. Pre-Quaternary spores present. Sterile.
330	2.5YR 5/2	dark grayish yellow	Sandy Clay Silt. Pond deposit. Very strong HCl reaction. Pre-Quaternary spores present. Sterile.
360	2.5YR 4/6	olive brown	Sandy Clay Silt. Coal present. Pond deposit. Strong HCl reaction. Pre-Quaternary spores present. Sterile.

FIGURE 2

Taxon List: Boss Hill Site Sample # ON2E-70 CM

Trees and Large Shrubs:

PINACEAE

- Conifer, unidentifiable (Con. un.)
- Pinus

CAPRIFOLIACEAE

- Symphoricarpos occidentalis type (Buckbrush, Wolfberry)

Small Shrubs and Herbs:

COMPOSITAE

- Artemisis (Artem)
- TUBULIFLORAE High Spine (Com. H.S.)

GRAMINAEAE (Gramin)

CYPERACEAE (Cyperac)

Aquatics and Semi-Aquatics:

- nil

Pteridophyta and Atracheata:

- Lycopodium clavatum (Lyco cla)
- Selaginella (Selagin)
- Botrychium (Botrych)
- POLYPODIACEAE (Polypod)
- Equisetum (Equiset)
- Sphagnum (Sphag)

Unidentifiable Pollen and Spores:

Pollen

- Tricolporate/tricolpate (TCP/TC)
- Triporate (Tripor)
- Unidentifiable (Unident)

Spores; Quaternary

- Trilete, unidentifiable (Tri und)

Pre-Quaternary

- Trilete, unidentifiable (Tri und)
- Aquilapollenites (Aquilap)
- Reticulatisporites (Tri rect)

Forms; Other:

- Charcoal/coal (Ch/coal)
- Form 411 (Fungal spore)
- Form 420 (Dyad unknown)

Figure 3

Pollen/Spore Preservation Data Sheet: Sample: ON2E ; Slide # 1 ; Location: Boss Hill , Locality 1; Elevation: 70 cm.

Comments: 50 g sediment sampled; polleniferous residue suspended in 300 lambda of silicone oil from which a 75 lambda sample was counted.
Coding: n=7.5YR 6/8 - 7/8; 4=5YR 4/8 -5/8; 6=10R 2/3 - 3/4 - 4/8 -5/8; 7=n+6; *=aggregates b=black.

FEATURES		NORMAL			FOLDED (F)			SPLIT (S)			PERFORATED(P)			F/S/P			F/S			F/P			S/P			
SCULPTURE		E	G	P	E	G	P	E	G	P	E	G	P	E	G	P	E	G	P	E	G	P	E	G	P	TOTAL
TAXA																										
Con. un.	n1						3									8			3			13				27
Pine	n1			2																						2
Sym occ	n1		4	1		11															3					19
Sym occ	n*			2																						2
Artem	n1			3			2															1				6
Artem	n*			2																						2
Artem	4*			10									7								2					19
Artem	4						1						4									6				11
Artem	6												2													2
Artem	7*												2													2
Artem	7												3													3
Gramin	n*						2																			2
Gramin	n						2															1			1	4
Cyperac	n		1			2	1														1					5
Com H.S.	n*		2																							2
TCP/TC	n*						4																			4
TCP/TC	n		2				3																		3	8
TCP/TC	4						1																		7	8
TCP/TC	4*																								4	4
TriPor	n						2																			2
Lyco cla	n		1																							1
Selagin	n	3							1																	4
Botrych	n	1																								1
Polypod	n		1			1	8															1			10	21
Polypod	7																								7	7
Sphag	n					1																				1
Equiset	n						1																			1
Aquilap	n			1																						1
Tri rect	6																								1	1
Tri und	n					1	9															2			1	13
Tri und	4						1															1				2
Tri und	7																								1	1
Unident	n						6															1			1	8
Form 411	6		10																							10
Form 420	6	7																								7
Ch/coal	b																									41

Figure 4

BOSS HILL SEDIMENTOLOGICAL ANALYSIS (FdPe4: Locality 2)

DEPTH CM/BS.	STANDARD COLOUR	COLOUR DESCRIPTION	GRANULOMETRIC COMPOSITION % Sand	% SILT	%CLAY	TEXTURE
000-010	5YR 3/2	dark reddish brown	not processed			Ah Horizon
010-020	5YR 3/1	brownish black	47.94	47.38	04.67	Silty sand
020-030	5YR 2/2	brownish black	51.30	37.70	11.00	Silty sand
030-040	5YR 4/1	brownish gray	45.07	40.50	14.43	Silty sand
040-050	7YR 5/2	grayish brown	47.33	35.83	16.84	Silty sand
050-060	10YR 4/3	dull yellowish brown	27.94	40.98	31.08	Sandy clay silt
060-070	10YR 5/3	dull yellowish brown	36.11	38.33	25.56	Sandy clay silt
070-080	7YR 5/1	brownish gray	29.29	40.30	30.41	Sandy clay silt
080-090	7YR 6/1	brownish gray	14.01	50.34	35.65	Clayey silt
090-100	10YR 6/1	brownish gray	14.84	49.97	35.17	Clayey silt
100-110	10YR 6/1	brownish gray	14.81	50.90	34.29	Clayey silt
110-120	10YR 6/1	brownish gray	13.52	52.17	34.31	Clayey silt
120-130	10YR 7/1	light gray	24.67	42.02	33.31	Sandy clay silt
130-140	10YR 7/1	light gray	26.03	41.72	32.25	Sandy clay silt
140-150	10YR 7/1	light gray	06.89	57.62	35.49	Clayey silt
150-160	10YR 7/1	light gray	06.86	63.52	29.62	Clayey silt
160-170	10YR 7/1	light gray	12.88	55.57	31.55	Clayey silt

DEPTH	STANDARD COLOUR	COLOUR DESCRIPTION	GRANULOMETRIC COMPOSITION % Sand	% SILT	%CLAY	TEXTURE
170-180	10YR 7/1	light gray	10.58	70.69	18.73	Clayey silt
180-190	10YR 7/1	light gray	07.99	77.78	14.23	Silt
190-200	10YR 6/2	grayish yellow brown	07.02	56.74	36.24	Clayey silt
200-210	10YR 6/2	grayish yellow brown	05.39	51.31	43.30	Clayey silt
210-220	2.5YR 5/2	dark grayish yellow	33.81	37.69	28.50	Sandy clay silt
220-230	10YR 5/2	grayish yellow brown	12.35	48.13	39.52	Clayey silt
230-240	10YR 5/2	grayish yellow brown	45.11	29.76	25.13	Silty clay sand
240-250	10YR 5/2	grayish yellow brown	12.98	47.52	39.50	Clayey silt
250-260	2.5YR 5/1	yellowish gray	09.33	51.90	38.77	Clayey silt
260-270	10YR 4/2	grayish yellow brown	13.18	55.29	31.53	Clayey silt
270-280	10YR 4/2	grayish yellow brown	14.99	48.86	36.14	Clayey silt
280-290	10YR 4/2	grayish yellow brown	14.41	54.29	31.30	Clayey silt
290-300	10YR 5/2	grayish yellow brown	16.99	49.27	33.74	Clayey silt
300-310	10YR 5/3	dull yellowish brown	20.53	46.55	32.92	Sandy clay silt
310-320	10YR 6/2	grayish yellow brown	05.13	55.73	39.14	Clayey silt
320-330	not processed					
330-340	10YR 6/3	dull yellow orange	04.46	54.32	41.22	Clayey silt

Figure 5

BOSS HILL SEDIMENTOLOGICAL ANALYSIS (FdPe4: Locality 1)

DEPTH CM/BS.	STANDARD COLOUR	COLOUR DESCRIPTION	GRANULOMETRIC COMPOSITION % Sand	% SILT	%CLAY	TEXTURE
ON2E-70	10YR 3/2	brownish black	86.05	8.02	5.93	Sand
ON2E140	10YR 3/4	dark brown	82.32	13.05	4.633	Sand

Figure 6

TEXTURAL TERNARY DIAGRAM
(after Shepard 1954)

Boss Hill (Fd Pe 4)

1:	n/a	19:	180-190 cm
2:	010-020 cm	20:	190-200 cm
3:	020-030 cm	21:	200-210 cm
4:	030-040 cm	22:	210-220 cm
5:	040-050 cm	23:	220-230 cm
6:	050-060 cm	24:	230-240 cm
7:	060-070 cm	25:	240-250 cm
8:	070-080 cm	26:	250-260 cm
9:	080-090 cm	27:	260-270 cm
10:	090-100 cm	28:	270-280 cm
11:	100-110 cm	29:	280-290 cm
12:	110-120 cm	30:	290-300 cm
13:	120-130 cm	31:	300-310 cm
14:	130-140 cm	32:	310-320 cm
15:	140-150 cm	33:	320-330 cm
16	150-160 cm	34:	330-340 cm
17:	160-170 cm	35:	0N2E-70 cm
18:	170-180 cm	36:	0N2E-140 cm